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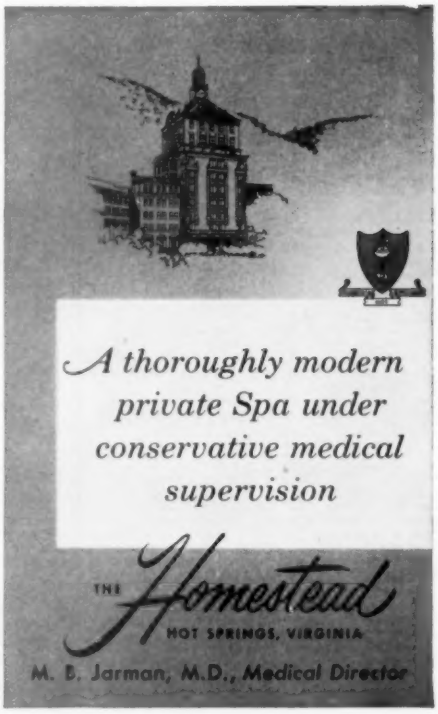

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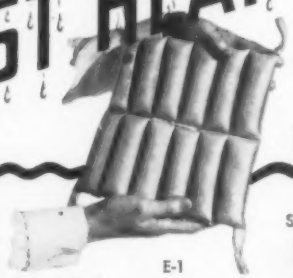

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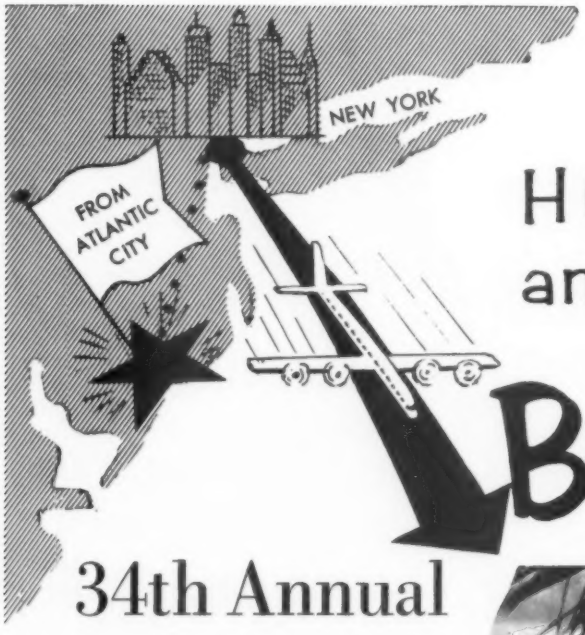

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Effect of Ultrasound on the Threshold of Vibration Perception in a Peripheral Nerve

William S. Alyea, M.D.
Donald L. Rose, M.D.
and
Edward B. Shires, M.D.
Kansas City, Kansas

Much of the literature pertaining to ultrasound and ultrasonic therapy relates to clinical observations. The lack of objective data on the biological effects of ultrasound as such has resulted in conflicting reports and occasionally erroneous conclusions. Any objective demonstration of a physiological action of ultrasound should contribute to a better understanding of the means of action of this physical agent.

Work with experimental animals has shown that nerve action potentials could be decreased in voltage and finally suppressed completely by high intensity ultrasound.[1] Changes in neural conductivity have been observed clinically as evidenced by changes in vasomotor tone following the use of ultrasound.[2, 3] An analgesic effect of ultrasound has been described;[4] this relief of pain was stated to be comparable to that produced by diathermy and various forms of conductive heat. The analgesic effect has been observed when the sensory nerve roots supplying a painful part were treated as well as when the painful area was treated locally.[5] Finally, encouraging results have been reported in the treatment of various forms of neuritis, especially sciatic neuritis, and in the treatment of painful postoperative neurofibromas.[6]

Actual measurements of various physiological changes in human subjects appear to be rare. Since reasonably accurate measurements of the threshold for perception of vibration is possible, the measurement of this threshold before and after ultrasonic irradiation of the peripheral nerve supplying that dermatome would seem to provide an objective method of investigation of this aspect of ultrasonic effects. It is the purpose of this report to summarize the initial findings of such a study.

Methods and Materials

The instrument employed for measurement of the threshold of vibration perception was the Bio-thesiometer. This is an electrical device wherein the intensity of vibration produced in a magnetically activated armature can be read on a galvanometer scale. The amplitude of vibration, and therefore the intensity of stimulus, varies directly with the square of the applied voltage. The voltage and voltage squared values can easily be determined for each threshold of perception of the vibratory stimulus. Ten consecutive determinations were made for each threshold and the average was recorded as more nearly representing the true threshold value.

Two different commercial makes of ultrasound generators of one megacycle frequency were employed. The sound head of one instrument had an effective contact area of 5 square centimeters, the other an area of 1 square centimeter. Energy intensities of 1.5 and 1.27 watts per square centimeter were employed at these sound heads respectively. With the arm to be tested comfortably positioned in abduction and external rotation and with the transducer coupled to the skin with light mineral oil, the sound energy was delivered to the region of the ulnar nerve at the ulnar notch by slow linear stroking for 5 minutes.

Twenty-five normal young adults were tested. In each subject, a basal determination of the vibration threshold was secured by measurements at the palmar aspect of the tip of the fifth finger. This area was selected as being supplied exclusively, so far as known, by the ulnar

The Bio-thesiometer is manufactured by the Bio-Medical Instrument Company, Newbury, Ohio.

The assistance of the Birtcher Corporation and the Dallons Laboratories is gratefully acknowledged.

Read at the Midwestern Section Meeting of the American Congress of Physical Medicine and Rehabilitation, Minneapolis, May 7, 1955.

From the Department of Physical Medicine, University of Kansas Medical Center.

The assistance of a Training Grant, National Institute of Neurological Diseases and Blindness is gratefully acknowledged by Dr. Alyea.

nerve. In 10 subjects of this group, the vibration threshold was also determined at the palmar aspect of the tip of the thumb. This area was selected as never being supplied, so far as known, by the ulnar nerve. Ultrasound was then applied to the ulnar nerve at its most superficial location at the elbow. The vibration threshold over the tip of the thumb and fifth finger was then redetermined immediately after, 1 hour after, and 24 hours after the application of ultrasound.

Results

The results of this experiment are summarized in table 1. It may be observed that a slight increase in vibration threshold occurred immediately after ultrasound in the digit supplied by the ulnar nerve, that an even greater increase occurred after a lapse of 1 hour, and that this effect disappeared by 24 hours. No significant change occurred in the vibration threshold of the digit not supplied by the ulnar nerve.

Table 1: Average of Threshold Measurements of Vibration Perception in Twenty-Five Subjects.

Voltage Reading	Tip of 5th Finger	Tip of Thumb
Initial Reading	6.8	7.7
Immediately after ultrasound	7.9	7.7
1 Hour after ultrasound	8.8	8.0
24 Hours after ultrasound	7.0	8.0
Threshold (Voltage Squared)		
Initial threshold	46	59
Immediately after ultrasound	63	59
1 Hour after ultrasound	78	64
24 Hours after ultrasound	49	64
Change in Threshold		
Immediately after ultrasound	17	0
1 Hour after ultrasound	32	5
24 Hours after ultrasound	3	5
Percentage Change in Threshold		
Immediately after ultrasound	37	0
1 Hour after ultrasound	70	8
24 Hours after ultrasound	7	8

Statistical analysis of the observed values is shown in table 2. The p values are statistically significant for both the immediate and 1-hour determinations but are not significant for the 24-hour observation at the tip of the fifth finger. The p values for the tip of the thumb are not statistically significant.

Table 2: Statistical Analysis of Values Presented in Table 1.

	Fifth Finger p	Thumb p
Immediately after ultrasound	$< .001$	.7
1 Hour after ultrasound	$< .001$	.15
24 Hours after ultrasound	.1	.15

No differences in threshold intensities were noted between the application of ultrasound through a 5 square centimeter head as compared with a 1 square centimeter head.

No attempt was made in this experiment to test vibration threshold perception in other than normal young adults, to test other threshold perceptions such as pain, or to compare these results with those that might be obtained when physical agents other than ultrasound were employed.

Conclusions

Thresholds for perception of vibration sensibility, measured by means of the Biothesiometer, were determined in 25 normal young adults. These determinations were made at the tip of the fifth finger and the thumb immediately after, 1 hour after, and 24 hours after the application of ultrasound to the ulnar nerve at the elbow. After the application of ultrasound there was an immediate mild increase in vibration threshold. A significantly greater increase was observed 1 hour later. This effect disappeared within 24 hours. No significant change occurred in the vibration threshold in an area not supplied by the ulnar nerve. Ultrasound in the dosage range commonly used clinically raises the threshold for perception of vibratory stimuli in the area supplied by the nerve so treated.

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Arthroplasty of the Hip: Pre- and Post-operative Management by Physical Medicine and Rehabilitation

Shyh-Jong Yue, M.D.
New York City

The purpose of arthroplasty of the hip is three-fold: to relieve or diminish pain, to restore or improve function, and to correct deformity. It is a major operation, the success of which depends upon the finest skill of the surgeon. The entire joint often needs complete reconstruction. The functional result may be enhanced if a well-planned program of physical therapy and rehabilitation immediately precedes and follows this operation. In this program, muscles around the hip are re-educated for mobilization of the newly formed joint. Strengthening of these muscles will increase the stability of the joint.

Vitallium Mold Arthroplasty

Arthroplasty of the hip at times requires shaping of two joint surfaces until they are mechanically suitable for function. The joint surfaces must be covered with a lining that will prevent ankylosis and will allow these surfaces to glide against each other. One of the major problems in this operation was to find a satisfactory interposing material for the newly constructed joint. Various kinds of materials were tested without success. In 1938, the discovery of Vitallium, an alloy that is inert to tissue reaction and strong enough to withstand constant pressure and grinding of the bony structure, enabled Smith-Petersen to establish his Vitallium mold arthroplasty of the hip.[1-3]

Smith-Petersen originally described his operation in two stages.[2] In the first stage, a Vitallium mold in the form of a cup is introduced between the two joint surfaces. The presence of such a mold helps to limit fibrous tissue formation at the periarticular region and takes the place of the joint capsule. Fibrocartilage is formed over the joint surfaces. In the second stage, the mold is removed and the joint surfaces regain their function. Although the second stage is recommended, this has largely been abandoned because the patient does well with the mold in place.

Vitallium mold arthroplasty of the hip has its limitations. In case of aseptic necrosis of the femoral head in fracture of the neck of the femur, the head of the femur has to be removed; therefore, the femoral neck is too short to hold the mold. Under such conditions, good results have been obtained with the original Whitman or Colonna reconstruction or modifications of this by placing a Vitallium mold on the trochanter or on the shaft of the femur as recommended by Wilson[4] and Smith-Petersen.[5]

Types of Prostheses

In 1950, R. Judet introduced an ac-

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rylic prosthesis to take the place of the femoral head.[6-8] This prosthesis takes the shape of a femoral head with a stem that is lodged in a drilled hole through the femoral neck until it emerges through the lateral cortex of the femur, beneath the greater trochanter. The results of this operation at times have been striking and they have touched off a new field of interest in the technic of arthroplasty of the hip.

In the past few years, over 20 types of prostheses have been designed and used. This type of operation is now generally called prosthetic replacement of the hip. The prostheses are made to replace the missing parts of the bony structure.

The types of prostheses used in a total of 799 cases[9] are listed in table 1. These may be divided into two groups. In the first group, the stem of the prosthesis is transfixed to the strong lateral cortex of the shaft of the femur. This group is represented by the Judet[6, 10, 11] and J.E.M. Thomson[12] types of prostheses. In the second group, an intramedullary pin is extended from the prosthetic head, and the stress of the prosthesis is transmitted to the shaft of the femur. This group is represented by the Austin Moore,[13] Frederick Thompson,[14] Eicher, Minneapolis, Lippman, and McBride[15] types of prostheses. The Committee on Scientific Investigation of the American Academy of Orthopedic Surgeons in a survey made in 1953, found a total of 5,082 prostheses was used by the members of the Academy.[9]

Most of the arthroplasties of the hip were done in patients with one of the following four disorders: fracture of the neck of the femur, with nonunion or aseptic necrosis of the femoral head; painful hip resulting from osteoarthritis; ankylosis of the hip caused by rheumatoid or Marie-Strümpell arthritis; and congenital subluxation or dislocation of the hip, with secondary arthritic changes. The indications for arthroplasty of the hip are listed in table 2.

Surgical Approach

Two types of surgical approach to the hip are generally accepted. The anterior or Smith-Petersen's approach has been the method of choice in the past decade. Increasingly popular is the posterior approach, also known as Gibson's approach.[16, 17] In a survey made by the American Academy of Orthopedic Surgeons in 1953, among 502 cases of arthroplasty of the hip, anterior approach was used in 201 (40 per cent), posterior approach was used in 239 (47 per cent),

Table 1: Types of Prosthesis Used in 799 Cases

Judet	267
Eicher	137
Naden-Reith	69
Frederick Thompson	61
Austin Moore	48
Collision	35
J. E. M. Thompson	30
Roger Anderson	27
Nylon	25
Judet, Vitallium	23
Minneapolis	12
McBride	10
Zimmer	8
Vitallium	8
Judet, Stainless Steel	7
Lorenz	6
Acrylic	4
Lippman	3
Others	19
Total	799

Table 2: Indications for Arthroplasty of the Hip

Congenital Anomalies
Congenital subluxation of the hip
Congenital dislocation of the hip
Arthritis
Tuberculous arthritis
Suppurative arthritis
Traumatic arthritis
Rheumatoid arthritis
Marie Strumpell arthritis
Osteoarthritis
Epiphyseal Disturbances
Slipping of the femoral capital epiphysis
Legg-Perthe's disease
Osteochondritis dessicans
Bone and Joint Injuries
Fracture of the neck of the femur, fresh
Fracture of the neck of the femur, ununited
Traumatic dislocation of the hip
Aseptic Necrosis of the Head of the Femur
Secondary to fracture of the neck of the femur
Secondary to traumatic dislocation of the hip
Secondary to caisson disease
Neoplasm

lateral and other approaches were used in 61 (13 per cent).[9]

The basic surgical procedure in each of these prosthetic replacement operations is about the same. The difference is in the way the mold or prosthesis is placed at the desired angle and position. The surgeon judges the stability of the joint after surgery is completed. In acute fractures where the acetabulum is well preserved, the patient can probably be allowed early ambulation. If a great deal of reconstructive work has been done, where cartilaginous surfaces of the acetabulum have been removed and extensively reamed, weight-bearing should be deferred.

Complications

Hip arthroplasty may be accompanied by many complications that will undoubtedly delay the rehabilitation program and prolong hospitalization.[18] Early complications include dislocation or subluxation of the mold or prosthesis. This may result from lack of adequate length of the femoral neck, a shallow acetabulum, or excessive valgus placement of the prosthesis. In the posterior approach, the sciatic nerve may be injured at the time of surgery and sciatic palsy may occur. Occasionally, patients are allergic to the material used in making the prosthesis, especially to nylon. Other early complications are wound infection and, in elderly patients, cardiovascular disturbances, thrombophlebitis, and pulmonary embolism.

Late complications may result from defect of the mold or prosthesis, that is, fracture or erosion of the acrylic type of prosthesis or breaking of the mold. Overstress of the prosthesis upon the bony structure may cause absorption of bone around the prosthesis, resulting in a loose prosthesis, varus deformity of the prosthesis, and stress fracture. Trochanteric bursitis may occur from irritation of the protruding stem of a Judet prosthesis. Pericapsular calcification or myositis ossificans, and persistent pain not relieved by operation, are other late complications.

Analysis of Cases

A review was made to study the management of arthroplasty of the hip in some of the patients that were operated upon between 1950 and 1954 at the New York Orthopedic Hospital of the Columbia-Presbyterian Medical Center. In a total of 76 patients, 88 arthroplasties were done: 37 had Smith-Petersen mold arthroplasty; 34 had Judet arthroplasty; 15 had Austin Moore arthroplasty; and 2 had Frederick Thompson arthroplasty. Table 3 shows the different types of arthroplasties performed each year in the past five years. Their indications are shown in table 4. The Smith-Petersen or anterior approach was used in 64 (72 per cent); the Gibson or posterior approach was used in 24 (28 per cent).

Table 3: Types of Arthroplasty Used at the New York Orthopedic Hospital from 1950 to 1954

	Vitallium Mold		Judet		Austin Moore		Frederick Thompson	
	No. of Cases	%	No. of Cases	%	No. of Cases	%	No. of Cases	%
1950	5	100	—	—	—	—	—	—
1951	4	25	12	75	—	—	—	—
1952	13	54	10	41	—	—	1	5
1953	13	52	7	28	5	20	—	—
1954	2	11	5	27	10	55	1	7
Total	37	42%	34	39%	15	17%	2	2%

Table 4: Indications for Arthroplasty of the Hip at the New York Orthopedic Hospital

Congenital dislocation of the hip with secondary arthritic changes	10
Suppurative arthritis with ankylosis	1
Traumatic arthritis	1
Rheumatoid arthritis	4
Marie-Strumpell arthritis	1
Osteoarthritis	28
Slipped femoral capital epiphysis with secondary arthritic changes	1
Legg-Perthe's disease with secondary arthritic changes	2
Fracture of the neck of the femur, fresh	2
Fracture of the neck of the femur, ununited	18
Dislocation of the hip, traumatic	1
Fracture of the acetabulum	1
Aseptic necrosis of the femoral head following fracture of the neck of the femur	5
Aseptic necrosis caused by caisson disease	1
Total	76

The postoperative management in this series of cases varied a great deal. The types of postoperative fixation and the progress from exercises to ambulation differed according to the surgeon and the individual case. Table 5 shows the differ-

Table 5: Types of Post-Operative Fixation in Arthroplasty of the Hip

	Vitallium Mold		Judet		Austin Moore		Frederick Thompson	
	No. of Cases	%	No. of Cases	%	No. of Cases	%	No. of Cases	%
No fixation	6	17	10	30	3	20	1	50
Balanced suspension	2	5	4	11	—	—	—	—
Wilkie boots	9	24	13	38	2	13	1	50
Plaster spica	20	54	7	21	10	67	—	—
Total	37	100%	34	100%	15	100%	2	100%

ent types of fixation used postoperatively. Table 6 shows the duration of immobilization in patients with Wilkie boots and plaster spica. The average postoperative days up to the time the patient was discharged from the hospital after mold arthroplasty was 55.9 days; after Judet arthroplasty, 42.6 days; and after Austin Moore arthroplasty, 50.6 days. However, if patients who had serious complications that delayed recovery are deducted, the average hospital days in mold arthroplasty from the time of operation was 50.6 days; Judet arthroplasty, 37.5 days; and Austin Moore arthroplasty, 42.5 days. Figures 1 to 4 illustrate various types of arthroplasty.

Table 6: Duration of Postoperative Immobilization in Arthroplasty of the Hip

	Vitallium Mold No. of Cases	Judet No. of Cases	Austin Moore No. of Cases	Frederick Thompson No. of Cases
Plaster of Paris Spica				
1 week	5	1	2	—
2 weeks	10	2	4	—
3 weeks	4	3	3	—
4 weeks and over	1	1	1	—
Total	20	7	10	—
Wilkie Boots				
1 week	1	1	—	—
2 weeks	7	7	1	1
3 weeks	1	5	1	—
4 weeks and over	—	—	—	—
Total	9	13	2	1

The management of arthroplasty of the hip is a complicated problem. The factors involved are the conditions of the muscles around the hip before operation, the success of the operation, how well physical therapy has been carried out, and how cooperative the patient is. It is difficult to set a date as to when the patient may sit or stand. In our series of Judet arthroplasties, one patient was on crutches on the 5th day and another on the 48th day. In order to get the best result from physical therapy and rehabilitation, the following program, which may be applied to all forms of arthroplasty, is proposed.

Management of Arthroplasty of the Hip by Physical Medicine and Rehabilitation

From the point of view of physical medicine, physical therapy should be started long before the operation. If an arthroplasty of the hip is contemplated, and the hip is not ankylosed, a strenuous course of range of motion and active resistive exercises within the limits of pain should be given. When the patient is admitted to the hospital, physical therapy should begin. Of course, preoperative treatment is not indicated in acute injuries of the hip. Instructions for crutch-walking without weight-bearing on the side to be operated upon should be started even in those with ankylosed hips. For painful hip with limited range of motion, muscle setting exercises and active resistive exercises may be carried out to the beginning of pain.

The physiatrist should have full information about the operation. He should know the surgical approach, the type of prosthesis used, and the stability of the joint as judged at the time of surgery. Physical therapy should begin as soon as the patient recovers from the anesthesia and shock of surgery. The treatment is divided into phases geared to meet the particular stage of recovery of the patient. The progress of treatment should be determined by the surgeon and the physiatrist. Customarily, the moment of ambulation and the amount of weight-bearing should be decided upon by the surgeon,

A B

Fig. 1 — *A:* Osteoarthritis of both hips of 6 years' duration in a 47-year-old white man. *B:* After a Vitallium mold arthroplasty was performed on the left hip. After the operation, the patient was in a plaster spica for 10 days. Active exercises were started on the 12th day; underwater exercises in a Hubbard tank, on the 19th day; bicycle exercises, on the 22nd day; crutch-walking, on the 23rd day. Weight-bearing was permitted on the 54th day. The patient was discharged from the hospital 8 weeks after the operation.

as they will vary in each individual case. The postoperative management is divided into three phases: static phase, when the patient is not ready for active motion and is more or less in a stage of immobilization; mobilizing phase, when exercise to increase the range of motion of the hip is carried out; and ambulatory phase, when the patient is ready for ambulation.

Static Phase: During the static phase four different types of immediate management are used postoperatively. These are immobilization of plaster of Paris spica, immobilization with Wilkie boots, immobilization with balanced suspension with or without traction, and no immobilization except local dressing. The duration of immobilization varies from one to three weeks. During this period, physical therapy should include muscle setting exercises of all the muscles around the hips, knees, and ankles of both sides, and gentle passive flexion of the knee by manual support under the knee or with suspension slings. Moving the patella in all directions helps maintain patella mobility. General activity of the uninvolved joints may be encouraged by all concerned with care of the patient; occupational therapy or recreational activities are indicated for this purpose.

Mobilizing Phase: During the mobilizing phase, immobilization is discontinued and the patient begins exercises. At the beginning, active assistive exercises are used. The patient is instructed to do exercises while the physical therapist helps him perform a greater range of motion within the limits of pain, and at the same time, to eliminate part of the weight of the limb. When the patient can actively exercise himself, he is instructed to carry out range of motion exercises, first with gravity eliminated, and later, proceeding against gravity. The physical therapist supervises the exercises. After this, the patient is able to exercise the hip against resistance. The resistance may be provided manually by the therapist or by mechanical devices such as pulleys and

Fig. 2 — A: Osteoarthritis of the right hip of 20 years' duration in a 67-year-old white man. B: After a Judet arthroplasty was performed on the right hip. After the operation, the patient was in a hip spica for 16 days. Active exercises were started after the plaster cast was removed; underwater exercises in a Hubbard tank, on the 24th day; crutch-walking, on the 31st day; bicycle exercises, on the 44th day. The patient was discharged from the hospital on the 51st day.

A

B

Fig. 3 — A: Osteoarthritis of the left hip of 3 years' duration in a 73-year-old white woman. B: After an Austin Moore arthroplasty was performed on the left hip. A plaster spica was applied for 9 days. Active exercises were started on the 12th day; underwater exercises in a Hubbard tank, on the 16th day; ambulation in a walker, on the 26th day; crutch-walking, on the 29th day; stair-climbing, on the 43rd day. The patient was discharged from the hospital on the 54th day.

A

B

A B

Fig. 4 — *A*: Simple comminuted fracture of the neck of the right femur of 5 days' duration in a 72-year-old white woman. *B*: After a Frederick Thompson arthroplasty was performed on the right hip. No postoperative fixation was used. Active exercises and walking in a walker were started on the 12th day; crutch-walking, on the 13th day; stair-climbing, on the 20th day. The patient was discharged from the hospital 4 weeks after the operation.

weights, weighted boots, up-inclined planes, or DeLorme's table.[19, 20] Active resistive exercises may be carried out as soon as the patient is able to overcome resistance.

The program of exercises is limited by the degree of activities the surgeon will allow the patient; therefore, the exercises are divided according to whether the patient is in a lying, sitting, or standing position. The position of the patient, however, does not affect the progress of exercises from active assistive to that of active resistive. The exercises should include flexion and extension, abduction and adduction, and internal and external rotation of the hip.

Abduction and adduction of the hip can best be carried out with the aid of roller skates. Strengthening of the hip abductors is important because this will provide stability to the hip. Adduction is permitted only to the neutral position, and further adduction is discouraged. This is a precaution to prevent dislocation of the hip in case the acetabulum is shallow.

Internal and external rotation of the hip takes into consideration the surgical approach. When the Smith-Petersen approach is used, the joint capsule is either incised or excised during the operation and the hip is dislocated by external rotation. Since excessive external rotation exercises may redislocate the hip, they should be discouraged. In the Gibson approach, the external rotators of the hip are sectioned during the operation and the hip is dislocated either internally or externally; therefore, both internal and external rotation exercises should be discouraged. Limitations in rotation are important only during the first two to four weeks. When sufficient amount of

healing is present, the patient may actively rotate his hip internally or externally within the range of pain.

These exercises should be done at least twice daily, under the supervision of a therapist, with adequate rest periods in between. This may be applied to all three phases in this program.

Besides the three regular forms of exercise, prophylactic strengthening of the dorsiflexors of the ankle will enable the patient to clear the ground while practicing walking. The hip elevators should be exercised in preparation for crutch walking. Underwater exercises in a Hubbard tank are helpful, especially when muscle spasm and pain prevent progress. The additional time that personnel must spend in therapy and the added cost to the patient prevent its use as a routine measure. If a therapeutic pool is available, the patient may exercise in the pool. Standing or walking in water may be helpful as preparation to ambulation.

Ambulatory Phase: General strengthening exercises on mats to limber up the patient are indicated at this time. Bodily activities will increase the muscle tone and physical fitness. Strengthening of triceps and shoulder depressors is useful in preparing for handling of crutches. Parallel bars supply stationary support, give secure stability, and therefore easiest balance, for the patient when first ambulatory. The patient learns to balance himself, walking with a three point gait, and walking forwards, backwards, and sideways. After the patient has gained sufficient confidence in standing balance and walking experience on parallel bars, he may proceed to practice in a walker. The amount of weight-bearing is to be determined by the surgeon. When the patient is able to walk well in a walker, crutch-walking may be started. Balancing technics will precede progressive movement. A three point gait is preferred. Again, the amount of weight-bearing is to be determined by the surgeon. Bicycle exercises, the use of the jigsaw in the occupational therapy workshop, or rocking-chair exercises are helpful as conditioning exercises for the hip operated upon. Before the patient is discharged from the hospital, stair-climbing and clearing of curbs should be taught. Instruction in activities of daily living should be given. Self-help devices such as hooks used as an aid in putting on socks and long shoehorns and elastic shoestrings may be very helpful to the patient.

During the entire course of treatment, the therapist constantly should be on the lookout for undue pain in the hip operated upon, any change in the contour of the hip, or pain and swelling in the leg. Complications such as dislocation of the hip operated upon or thrombophlebitis in the lower extremities should be detected early. If any such changes should occur, the therapist must immediately call them to the attention of the surgeon or the attending physiatrist.

It is our experience that when a patient is able to walk well on crutches, to climb stairs, and to clear curbs he should be discharged from the hospital. Since the entire program from the time of surgery to discharge from the hospital may be as short as two weeks, a home program should be arranged before the patient is discharged from the hospital. The effect of progressive resistive exercises will not be seen for two to three months. Unless the patient is instructed to continue these exercises as long as possible, he may lose what he has gained in the hospital. The Elgin adjustable door pulley assembly for home exercises is an excellent apparatus which may be purchased or rented. This equipment provides easily adjustable means for carrying out progressive resistive exercises by the patient without the help of a therapist. Regular follow-up in the office or clinic should be arranged by both the surgeon and the physiatrist.

Comment

A well-planned program in physical therapy and rehabilitation for arthroplasty of the hip is imperative. The treatments mentioned are not new or revolutionary. They have been used in many hospitals and clinics. If well coordinated in time and approach, they will help to produce better functional results. The progress of a patient is carefully graded. This program may not shorten the treatment period; on the contrary, the time

may be prolonged. If the patient is ambulant too early, over-stress and fatigue may cause muscular weakness, especially in the hip abductors, which will delay the progress. In a well-balanced program, the patient will have to proceed from one step to another, according to his accomplishments. The physiatrist shares responsibility with the surgeon in working cooperatively to supervise the program.

Summary

The management of arthroplasty of the hip, both preoperatively and postoperatively, by physical medicine and rehabilitation is outlined. A brief review in the progress of different types of arthroplasty is presented. An analysis of 76 patients with 88 hip arthroplasties at the New York Orthopedic Hospital of the Columbia-Presbyterian Medical Center is made. A program in preoperative and postoperative management of arthroplasty of the hip is proposed. This program includes the static, mobilizing, and ambulatory phases. The program is graded and, if well carried out, will improve functional results.

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Energy Requirements in Paraplegic Ambulation

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In uniform and moderate exercise minute oxygen uptake is constant and equal to oxygen consumption. The height to which this steady oxygen uptake may rise depends not only upon the intensity of work, but also upon the size of the working musculature. The ceiling to this height is modifiable by the individual's physical condition and determined by cardiorespiratory efficiency as well as blood and tissue factors.

If maximal oxygen uptake cannot satisfy energy requirements, anaerobic chemical processes supply the extra demand; however, breakdown products, including lactic acid, accumulate and finally preclude further activity, thus setting a limit for anaerobic work. During this process an oxygen debt is contracted, which must be ultimately repaid in the postexercise recovery period. If during exercise the oxygen debt exceeds a certain critical value determined by the degree of physical fitness, excess lactate appears in the blood. Below this critical level, no rise in blood lactate occurs; therefore, one can speak of an alactacid and lactacid oxygen debt.

It is evident from studies on normal subjects that oxygen uptake and debt are limiting factors to sustained physical activity. The presence of high concentrations of blood lactate is associated with severely exhausting work.

Clinical experience with the paraplegic suggests that muscular work is often intense. When to this observation is added the consideration that power is being supplied by relatively small muscle masses, one is forced to the conclusion that activity in any sustained form for many paraplegics is exceedingly stressful. Recently, a neuromuscular analysis of function available in various levels of spinal cord injuries has been published pointing out this limitation.[1] In a field so productive of research, the physiological counterpart of kinesiological analysis has not as yet been forthcoming. In order to define the energy requirements obtaining in paraplegic activity, a study was undertaken to ascertain the metabolic price paid by the paraplegic for his mobility and its relation to what he can bear to pay.

Method

Energy cost of physical work can be easily derived from oxygen consumption studies. Limitations of this method are due to variations of the caloric equivalent of 1 L. of oxygen. There is only a 4 per cent difference, however, between the basal state and exercise when mainly carbohydrate is utilized.

Oxygen uptakes were determined during physical activity and during the recovery period (O_2 debt). The standard open method technic was used as previously described.[2, 3] During the pursuit of these studies, it soon became clear that ambulation on level ground was the only work feasible for measurements of oxygen requirements, as this determination is predicated upon a suitable duration of uniform activity. For this purpose, climbing stairs, managing chair activities, and similar exertion proved too exhausting to maintain and did not lend themselves to smooth, uninterrupted rhythms of work; hence, level ambulation by a "swing-through gait" was selected as the test activity.

Eleven paraplegic patients served as subjects. Their clinical status and extent of disability are presented in table 1, where an attempt was made to range patients within each diagnostic group in order of decreasing involvement. Five displayed flaccid paralysis of the lower limbs, with or without trunk involvement, resulting from anterior poliomye-

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Table 1: Pertinent Clinical Factors at Beginning of Study.

Patient	Age	Diagnosis	Years	Extent of Disability and Bracing	Ambulating With Crutches
J. T.	18	Poliomyelitis	6	Lowers O; trunk fl. P, ext. G; uppers G to N; intercostals impaired; long leg braces with pelvic band and Knight brace.	48 months
D. M.	22	Poliomyelitis	3	Lowers O; lower trunk O, upper trunk N; long leg braces with pelvic band and Knight brace.	30 months
R. W.	18	Poliomyelitis	6	Lowers O; trunk fl. P, ext. F; long leg braces with pelvic band and Knight brace.	36 months
W. D.	28	Poliomyelitis	4½	Lowers O; trunk fl. O to P, ext. G to N; bilateral long leg braces.	48 months
E. J.	40	Poliomyelitis	5½	Lowers O; long leg brace with pelvic band.	5 years
J. J.	44	Myelopathy, traumatic	10	Physiological level-T4; long leg braces with pelvic band and Knight brace.	10 years
L. R.	32	Myelopathy, traumatic	3	Physiological level-T8; long leg braces with pelvic band.	30 months
S. B.	31	Myelopathy, luetic and traumatic	5	Physiological level-T8; long leg braces. Severe spasticity.	48 months
H. B.	26	Myelopathy, traumatic	3½	Injury of conus and cauda equina with physiological level at L1 and flaccidity; long leg braces.	24 months
F. P.	19	Cerebral Palsy	—	Spastic lowers, minimal involvement of uppers; no braces.	15 years
W. L.	19	Cerebral Palsy	—	Spastic lowers; no involvement of uppers; no braces.	4 years

litis. Four patients had suffered injury to the spinal cord and showed no physiological function below the levels T4, T8, T8, and L1 respectively. The last had flaccid, the others, spastic paralysis. The remaining two patients had cerebral palsy. Along with a history of motor impairment since birth, they manifested a type of spastic paralysis of the lower extremities consistent with brain damage. In one (F. P.) the upper extremities showed minor evidence of clumsiness, but no spasticity or other significant deviation from normal. They did not require braces for crutch ambulation, at which both were quite facile. The other nine patients with spinal cord involvement had been taught ambulation 2 to 15 years previous to the studies.

To obviate any effects that might be attributed to lack of training, the subjects engaged in supervised ambulation in the gymnasium for 2 to 4 weeks immediately prior to the investigation. In addition, preliminary practice runs were carried out to familiarize them with the procedures. A typical experiment was then run off as follows. In the basal state, the oxygen uptake and respiratory and pulse rates per minute were determined. The subject then rested for 10 minutes in the seated position and another determination of oxygen uptake per minute was made to provide a base line for the recovery period. He then started ambulating at a set rate of speed on an oval course, measuring a total of 70 ft. The long parallel sides of the oval measured 24 ft. Thus, progression in a straight line alternated with a turn gradual enough to allow a constant speed. Each time the subject entered a straight leg of the course, his rate was checked with a stopwatch within ½ second. The first 2 minutes of ambulation served as a preliminary period allowing approach to a steady state; then, a timed collection of expiratory gases was carried out usually for 3 to 4 minutes, or less if the subject tired readily. Respiratory rates were counted during the collection period by watching the movement of a light piece of paper mounted at the inspiratory inlet of the respiratory valve. The number of strides per 24 ft. were also recorded in some experiments. At the end of the period of activity, the subject resumed his seat and immediately expiratory gases were collected each minute separately for three successive minutes (occasionally for four). From these fractionated samples, oxygen debt as an index of the anaerobic work could be calculated. Pulse rates were counted every 15 seconds for 20 to 30 minutes from the time of cessation of activity.

In addition to these measurements, in six subjects lactic acid levels were de-

termined from blood derived by finger puncture. Samples were taken immediately prior to ambulation, at the beginning of the recovery period, and at intervals up to 30 minutes. Lactic acid determinations were carried out according to the Edwards' modification[4] of the procedure of Friedemann, Cotonio, and Shaffer.

In a given subject, experiments were made at various speeds of ambulation. The lowest used was 88 ft./min.; the highest, whatever rate could be maintained up to 6 minutes as established by trial on a previous day (table 2).

Table 2: Average Oxygen Uptakes per Minute in Multiples of B. M. R. (M. U.) at Various Rates of Ambulation on a Level.

Ft./min.	88	106	123	141	176	194	229	282
Poliomyelitis patients								
J. T.	4.3	4.4	4.5	4.9	—	—	—	—
D. M.	3.5	3.4	3.9	4.5	4.7	5.2	—	—
R. W.	3.7	—	4.2	4.3	4.5	4.8	—	—
W. D.	—	—	3.3	3.7	—	—	—	—
E. J.	4.7	—	5.6	6.2	6.1	6.6	—	—
Myelopathy patients								
J. J.	4.4	3.9	—	—	—	—	—	—
L. R.	4.2	—	—	4.8	—	—	—	—
S. B.	4.8	4.9	5.8	5.8	6.4	—	—	—
H. B.	3.7	—	3.7	4.9	5.3	5.4	—	—
Cerebral palsy patients								
F. P.	3.8	4.4	4.3	4.7	5.2	6.2	7.1	7.6
W. L.	3.3	—	3.4	4.0	4.9	5.9	6.7	—

$$\text{M. U.} = \frac{\text{Working O}_2\text{ Uptake/Min.}}{\text{B. M. R.}}$$

Results

One would expect variations in maximal speed attained from individual to individual on the basis of functioning musculature. Table 2 presents confirmation of this prediction in a general way. The most severely involved (J. T. and J. J.) are at the low end of achievement; the subjects with cerebral palsy, who retain good trunk and fair leg control, reached the highest speeds. (Subject W. D. is only an apparent exception as he was not tested beyond the rates indicated). The relationship of maximal speed and residual muscle mass is also illustrated in the group with myelopathy: H. B. with a physiological level at L1 achieved 194 ft./min.; while J. J., with a T4 lesion, could never exceed 106 ft./min., and then for no more than 2½ minutes. The other two subjects were in an intermediate position.

Oxygen Uptake per Minute During Ambulation: Since oxygen uptake expressed in cubic centimeters per minute is a function of size of the subject as well as the intensity of work, for comparison among many individuals it is better expressed in terms of metabolic units (M. U.).[5] These units represent the working oxygen consumption per minute in multiples of the basal consumption:

$$\text{M. U.} = \frac{\text{Working O}_2\text{ uptake/min.}}{\text{B. M. R.}}$$

Table 2 compares the metabolic activities during different speeds in the same individual, and between different individuals progressing at the same speed. Even at speeds of 88 ft./min., the metabolic work is three times the basal or more in all subjects. At higher speeds, the metabolic rate approached a level five to seven times basal metabolism. In a general way, the increments of change in oxygen uptake per minute follow a linear relationship with increasing speeds of ambulation.

The second comparison mentioned suggests that the greater the extent of lost function, the greater the expenditure of energy required to maintain the same speed. In the poliomyelitis group, the values for metabolic units fall in a descending order, with one patient (E. J.) a glaring exception. The values for the cerebral palsy group are also consistent in this regard. The group with transverse myelitis is also indicative, although one patient (S. B.) represents a deviation. In general, then, the metabolic results are in harmony with what anyone working with the disabled knows: the greater the motor impairment, the greater the effort and the less the output. The exceptions are interesting and instructive, for it would appear that other factors exert an influence upon energy requirements.

The subject with the least motor involvement in the poliomyelitis group (E. J.) had one of the highest expenditures. He was the oldest (40 years) and

heaviest. The other four ranged in age from 18 to 28 and were not overweight.

The ages of the two patients with a physiological level at T8 were similar and both had roughly the same duration of disability (table 1); however, they differed in two respects. One subject (S. B.) wore bilateral long leg braces without a pelvic band, while the other (L. R.) derived more stability from a pelvic band. In addition, the former patient displayed a severe degree of spasticity which occasionally caused postponement of the experiment to another day. For these two reasons, he could have had a wasteful expenditure of energy which contributed nothing to progression.

On the basis of this small series, it would appear that, aside from residual physiological function, metabolic requirements in ambulation may be modified by age, weight, degree of spasticity and, most important because the most amenable to treatment, stability afforded by bracing. Further evidence will be adduced regarding the favorable effect of bracing upon metabolic requirements.

Oxygen Debt: Oxygen debt in terms of metabolic units is presented in table 3, obtained simply by dividing the found oxygen debt by the total ambulation time, and this result, again, by the B. M. R. All of the severely involved individuals in the myelopathic group (levels T4 to T8) had contracted rather large oxygen deficits even at 88 ft./min. In the poliomyelitis group two patients (J. T. and E. J.), as expected, stood high in the list. The value for one (R. W.) at 88 ft./min. appears to be in error considering those at other speeds. At maximum speeds (194 to 282 ft./min.), the increases above basal in four subjects (E. J., J. J., S. B., and F. P.) were about 2 and for one patient (J. T.) about 1.5. With increasing speeds, the curve of ascent of oxygen requirements per minute often rose steeply. Since the curve of aerobic work was linear, this implied a greater proportion of anaerobic work (O_2 debt) as physical activity increased. In normals at high levels of physiological work, the increments in oxygen debt have also been shown to follow a steeply ascending curve, but this occurs with running at 880 ft./min. (10 mph).[6]

Table 3: Average Anaerobic Work per Minute in Metabolic Units.*

Ft./min.	88	106	123	141	176	194	229	282
Poliomyelitis subjects								
J. T.	1.2	0.8	1.0	1.4	—	—	—	—
D. M.	0.4	0.4	0.6	0.4	0.7	0.8	—	—
R. W.	0.7	—	0.6	0.6	0.7	0.9	—	—
W. D.	—	—	0.3	0.4	—	—	—	—
E. J.	0.9	—	0.8	1.3	1.2	1.7	—	—
Myelopathy subjects								
J. J.	1.5	1.8	—	—	—	—	—	—
L. R.	1.0	—	—	1.6	—	—	—	—
S. B.	1.4	1.4	1.2	2.1	2.5	—	—	—
H. B.	0.5	—	0.6	0.7	1.1	1.3	—	—
Cerebral palsy subjects								
F. P.	0.4	0.4	0.5	0.3	0.6	1.1	1.2	1.6
W. L.	0.2	—	0.4	0.3	0.6	0.7	1.2	—

*Average O_2 debt./min. / B. M. R.

Table 4: Observed Values of Average Oxygen Consumption per Minute in One Patient (W. D.)

Rate of Ambulation, Ft./Min.	Duration of Measured Collection, Min.*	Actual Duration of Activity, Min.	Average O_2 Uptake, Cc./Min.	Diff., %
123	4.90	4.90	810	——
123	3.10	5.10	844	+4
141	4.78	4.78	840	——
141	2.72	4.72	952	+13
150	4.80	4.80	882	——
150	2.67	4.67	908	+3

*O_2 consumption/min. was measured during 5 min. of ambulation by collection of expired air over the entire period of activity or excluding the first 2 min.

The second of each pair of experiments corresponds to the pattern used in this study.

Total Oxygen Requirements During Ambulation: It is obvious that oxygen uptakes alone give partial assessment of the energy requirements in such a high level activity as paraplegic ambulation. The anaerobic components (O_2 debt) during activity in these subjects were sizeable (table 3). For example, along with the high oxygen uptakes per minute, those most severely involved (J. T. and J. J.) and those handicapped in other respects already mentioned (E. J. and S. B.) tended to develop the highest oxy-

gen debts at the same speeds. Hence, a serious error would be introduced if oxygen debts were neglected in the determination of oxygen requirements. To reduce the values to comparable terms, total oxygen requirements (O_2 uptake/min. plus O_2 debt./min.) during ambulation were calculated and expressed in metabolic units. This calculation presented a difficulty, arising from technical demands of the experimental procedure in respect to the consideration of steady state.

The total oxygen requirement must be derived for the total time of activity, that is, during the 2-minute preliminary period plus the timed collection period. Since the collection of expired air was begun after the preliminary period, values for average oxygen uptake per minute actually apply only to the duration of ambulation after the first 2 minutes. These values may be higher than actual minute uptake for the first 2 minutes, when aerobic work is steadily rising toward a maximum. On the other hand, oxygen debt applies to the entire duration of work including the preliminary 2 minutes; in fact, a preponderant proportion of anaerobic work may occur in this time. For purposes of calculation, therefore, the total time was already fixed, extending from the beginning of the preliminary period to the end of ambulation. Since the measured oxygen consumptions per minute were applied to the first 2 minutes as well, the resulting calculations of total oxygen requirement probably erred on the high side.

To ascertain the degree of error so obtained, several paired experiments were carried out in one subject (W. D.) in whom oxygen uptakes during ambulation were measured either from the beginning of activity or after the end of 2 minutes of activity. The total duration of activity remained invariable. Table 4 shows the average oxygen uptake per minute determined by these alternative methods at three different rates of speed. As predicted, the average values are higher when determinations exclude the

Table 5: Average Total Oxygen Requirements at Various Speeds Calculated from Aerobic plus Anaerobic Oxygen Consumptions.*

Ft./min.	88	106	123	141	176	194	229	282
Poliomyelitis subjects								
J. T.	5.5	5.2	5.5	6.3	—	—	—	—
D. M.	3.9	3.8	4.5	5.2	5.4	6.0	—	—
R. W.	4.4	—	4.8	4.9	5.2	5.7	—	—
W. D.	—	—	3.6	4.1	—	—	—	—
E. J.	5.6	—	6.4	7.5	7.3	8.3	—	—
Myelopathy subjects								
J. J.	5.9	5.8	—	—	—	—	—	—
L. R.	5.2	—	—	6.4	—	—	—	—
S. B.	6.2	6.3	7.0	7.9	8.9	—	—	—
H. B.	4.2	—	4.3	5.6	6.4	6.7	—	—
Cerebral palsy subjects								
F. P.	4.2	4.8	4.8	5.0	5.8	7.3	8.3	9.2
W. L.	3.5	—	3.8	4.3	5.5	6.6	7.9	—

*Obtained by addition of corresponding values of tables 2 and 3.

Table 6: Concentrations of Blood Lactic Acids up to One-Half Hour after Activity (Arranged in Magnitude of Oxygen Debts).

Subject	Rate, Ft./min.	O_2 debt, Cc.	Lactic Acid (mg. %) Minutes after Activity. Resting	0-1	1-3	3-5	5-8	8-12	12-16	16-20	20-30	O_2 Requirement, M. U.
F. P.	150	310	13	—	10	10	24	10	—	9	—	5.0
F. P.	123	390	25	25	—	27	26	19	13	—	—	4.8
W. L.	202	490	17	15	24	18	14	—	13	20	—	5.2
F. P.	176	540	13	—	12	13	16	22	—	12	—	5.7
W. D.	150	650	23	—	13	—	15	14	—	20	16	4.4
W. L.	202	730	26	—	30	29	41	23	—	—	21	6.5*
W. L.	238	940	23	—	19	25	30	35	—	—	—	7.5
J. T.	150	940	13	—	—	—	75	63	—	—	—	6.4
S. B.	88	1300	8	—	—	43	38	31	31	—	37	6.3
S. B.	123	1350	10	—	33	44	40	—	33	—	—	6.8
S. B.	88	1460	13	—	34	—	31	27	—	—	25	6.0
F. P.	282	1480	25	—	64	—	60	52	—	40	31	9.2
S. B.	141	1690	19	—	60	—	70	65	—	62	50	8.2
E. J.	202	1760	21	—	47	—	—	31	22	18	—	8.3
S. B.	176	1890	40	77	—	—	70	—	67	—	75	8.9

*Equivalent to 1250 cc./min.

first 2 minutes, but, except at 141 ft./min., are within experimental deviations. It is felt that no great error is introduced by the assumption that the average oxygen minute uptake as determined may be applied to the entire work period; therefore, average total oxygen requirements for ambulation were calculated as follows:

$$\text{M. U. of Average Total } O_2 \text{ Requirement} = \frac{\text{Av. } O_2 \text{ uptake/min.} + \text{Av. } O_2 \text{ debt/min.}}{\text{B. M. R.}}$$

Table 5 compares the oxygen requirements in metabolic units in all individuals at various speeds. Metabolic activity was generally 4 to 5.5 times that of basal at low speeds and, in many cases, approached a level 6 to 8 times basal at speeds of 176 to 229 ft./min.

Blood Lactic Acid: In six subjects, blood lactic acid concentrations were followed immediately after activity up to 30 minutes. When the findings are arranged in ascending order of magnitude of oxygen debts, it will be seen that the blood lactic acid levels also follow the same general pattern (table 6). Thus, up to oxygen debts of 650 cc. there are no well-marked elevations. Above 700 cc. excess lactic acid appears in the blood, the degree roughly paralleling the anaerobic work. One subject (E. J.) represented a minor deviation in that, with a debt of 1,700 cc., instead of 60 to 70 mg. per 100 cc., the greatest rise encountered was 47 mg. per 100 cc. A female subject (J. T.), developed lactate levels at 940 cc. seen in the others with debts of 1,500 cc. or over; she had involvement of the respiratory musculature. In spite of individual differences, it may be tentatively suggested that, at least in our subjects, alactacid oxygen debts occurred up to the magnitude of a 650 cc. deficit; above this level, extra lactic acid invariably appeared in the blood.

The relationship of rise of blood lactate to total oxygen requirement per minute has been investigated in normal individuals. Those accustomed to physical exertion will begin to show lactacid debts when the oxygen requirements reach 2,000 cc. per minute.[5] As our subjects were also accustomed to physical activity, they may be compared to them. In the last column of table 6, the oxygen requirements in metabolic units have been entered; these figures suggest that paraplegics develop lactacidemia when the demand exceeds 6 M. U. or 1,250 cc. of oxygen per minute. Assuming a 70 kg. man with a muscle mass of 28 kg., a lactacid debt is contracted when oxygen requirements reach 72 cc. per minute per kilogram of body weight. According to our figures, assuming two-fifths to one-third residual musculature, the paraplegic would be represented by 110 to 130 cc. per minute per kilogram. This discrepancy results probably because the latter is more highly trained for activity and, consequently, by ability to meet large oxygen debts, displays maximal adaptation to great physiological stress.

Pulmonary Minute Volume: In view of the partial impairment of the costal respiratory mechanism in some of our subjects (particularly J. T., J. J., L. R., and S. B.), the pulmonary ventilation per minute was examined in relation to the intensity of metabolic activity. Ordinarily, a linear relationship exists between rising oxygen uptake per minute and pulmonary ventilation per minute. In this respect, our findings do not differ, if allowances are made for considerable individual deviations. The interesting point, however, is the steepness of ascent (slope) of the line relating rise of pulmonary ventilation per minute with each unit rise in oxygen uptake. In all subjects with intact costal musculature, the slopes were roughly unity or less. In two patients with impaired costal musculature (S. B. and J. T.) the slopes were definitely above unity, 1.2 and 1.5 respectively. This would indicate a larger ventilatory volume per 1,000 cc. of oxygen absorbed, and consequently a lowered ventilatory efficiency. The lowest slopes were attributed to the two subjects with cerebral palsy.

Basal Metabolic Rate: With loss of up to two-thirds of the total muscle mass in our poliomyelitis victims, it was thought of interest to present these determinations related to the standards calculated from

the height-weight formula. In each individual 5 to 10 determinations of B. M. R. were made, with only an occasional subject deviating from the mean in one observation by over ± 10 per cent. Table 7 presents height, weight, B. M. R., and average measured oxygen consumption per minute for each subject. In the five poliomyelitis subjects there was excellent correspondence between the mean determined and predicted values: −3 per cent, −7 per cent, +1 per cent, −4 per cent, −4 per cent. In the patient with flaccid paralysis caused by a lesion of the cauda equina (H. B.), the found B. M. R. was +2 per cent. The other subjects with cord injuries gave −14 per cent, +7 per cent, −2 per cent; and the individuals with cerebral palsy presented values of −14 per cent and +11 per cent. Evidently at rest spasticity does not share in the influence upon B. M. R., nor does atrophy of large muscle masses invalidate the predictions based upon surface area.

Table 7: Data for Determination of B. M. R.

Subject	Height, In.	Weight, Lb.	Av. O_2 Cons.,* Cc./Min.	B. M. R.
J. T.	64.5	102	174	−4
D. M.	69	128	223	−4
R. W.	71	147	266	+1
W. D.	74	158	255	−3
E. J.	72	169	234	−7
J. J.	68.5	181	245	−2
L. R.	72	134	234	+7
S. B.	69	151	207	−14
H. B.	72	130	245	+2
F. P.	59	96	216	+11
W. L.	65.5	116	192	−14

*Actually determined.

It has been estimated that in a "standard man" at rest the contribution to the B. M. R. by muscle tissue is 84 cc. per minute.[5] In our subjects, one may expect a maximum reduction in B. M. R. of about 20 per cent, but there are two compensating factors. Reduction in body weight would contract the predicted value; hypertrophy of residual muscle would tend to raise B. M. R. The estimate of 20 per cent deviation is, therefore, untenable both in theory and fact.

Influence of Bracing: Because one patient (J. T.) had observed more facility with a back brace, energy requirements were obtained with and without a Knight extension to the pelvic band. Table 8 compares the metabolic activity in four paired experiments under these two circumstances. Their sequence was switched to avoid the influence of training upon the results. In every respect, energy cost and oxygen debt were less with the Knight extension brace than without one. In short, absence of the spinal brace must be replaced by an excess expenditure of energy equivalent to the subject's B. M. R. The other example of extra work in the absence of adequate bracing has already been pointed out.

Discussion

This study was not designed to establish the heroic quality of exertion imposed by ambulation upon many paraplegics. Clinical observation has already given rise to the opinion that prescription of such an activity must be tempered with common sense, an attitude recently expressed succinctly.[7] From this point of view, it is disconcerting to read in the progress notes of one patient (J. J.), written a short time after his injury nine years ago, "(After several weeks) the patient finally succeeded in mounting a step after a terrific struggle"! As a practical aside, this patient now only ambulates one-half hour daily to maintain physiological balance. Reference to table 5 will indicate the reason: progression at merely 88 ft./min., raises his physiologi-

Table 8: Oxygen Consumption and Requirements per/Minute and Oxygen Debts in J. T.*

Date	Bracing	O_2 Cons./Min.	O_2 Requirement/Min.	O_2 Debt
3/12	without Knight	914 Cc.	1180 Cc. 6.8 M. U.	862
3/16	with Knight	793 Cc.	996 Cc. 5.7 M. U.	608
3/23	with Knight	694 Cc.	902 Cc. 5.2 M. U.	606
3/30	without Knight	812 Cc.	1080 Cc. 6.2 M. U.	913

*Rate of ambulation was 88 ft./min.

cal work to six times that of basal, a level impossible to maintain.

Nor was this study undertaken to abolish the practice of ambulation. This statement would be superfluous were it not for the possibility of misinterpretation. Its purpose is to define more clearly the physiological consequences of ambulation, in line with the sound medical practice of understanding not only the positive contributions of a therapeutic agent, but also its disadvantages and its dangers.

Many factors contribute to difficulty in ambulation. Age and weight have already been pointed out; motivation is a less tangible one. Inherent agility and coordination will undoubtedly continue to upset predictions based on purely anatomical reasoning. Economy of motion, particularly vertical motion, must influence working metabolism. This factor forms the subject of a future research. The integrity of exteroceptive and enteroceptive systems are certainly important, but it is difficult to say whether these factors shared in distinguishing the poliomyelitis from the myelopathy victims in this study. The degree of spasticity has already been mentioned as aggravating difficulty in ambulation. Bracing is another important factor. The pattern of the stride must also be of significance in contributing to the metabolic cost, but this was not studied. By far the most significant factor is the amount of nonfunctioning neuromuscular apparatus. Taking the nine subjects without complicating factors, on the basis of the determined M. U. at 88 and 141 ft./min., one can place them in the following order: J. J., J. T., L. R., H. B., D. M., F. P. and R. W., W. L., W. D. Table 1 discloses a fair parallelism between this arrangement and extent of physiological loss. Perhaps the position of the paraplegics toward the beginning of the series (J. J., L. R., and H. B.), denotes the disadvantage resulting from lack of peripheral sensation, inasmuch as some of the subjects with poliomyelitis fared better with equally large truncal deficits, or, perhaps from involvement of respiratory muscles.

In many subjects, long-maintained ambulation was prohibitive even at low rates. One subject (S. B.) showed a rise 6 to 9 times basal (severe work) over a range of 88 to 176 ft./min. (table 5); and further demonstrated his difficulty by the fact that, even at the lower speeds, a lactacid debt was accumulated (table 6). From a practical point of view, it was noted that only W. L., F. P., H. B., W. D., D. M. and R. W. could maintain low speeds (88 to 123 ft./min.). As shown in table 5, this would set the critical limit separating these individuals from the rest at about 5 M. U. of total oxygen requirements per minute (4 M. U. in terms of O_2 uptake per min.). Limits in terms of metabolic activity receive further validity from the fact that, while those subjects competent in ambulating 88 ft./min. could achieve 194 ft./min. or higher (W. D. excepted for lack of data), they could not sustain a steady state. This rate invariably occurred at an oxygen requirement of 6 M. U. Further powerful support for the existence of a ceiling for sustained ambulation at 5 to 6 M. U. is derived from an entirely independent source. Lactacid debts (table 6) were always associated with an energy requirement of 5 to 6 M. U. or over. This observation concurs with the metabolic data and explains why ambulation could not be maintained in our subjects when energy cost rose to this level: a lactacid debt and steady state are mutually exclusive for sustained activity.

In this light, insistence upon ambulation even at 88 ft./min. as the usual means of progression is unrealistic for J. T., E. J., J. J., L. R., and S. B. Indeed, these individuals were far more often seen in than out of their wheelchairs. On the other hand, the association of an alactacid debt with moderate speeds of ambulation in F. P., W. L., and W. D. coincides with the fact that they utilized crutch walking exclusively, and would indicate encouragement of ambulation in similarly handicapped individuals.

These figures, moreover, illustrate how the paraplegic "makes haste slowly." Physiological work is high; physical progression is slow. Translating the values here found in terms of normal activity,[8]

at the lower speeds most of the paraplegics were expending energy at the rate of 352 ft./min. or more; at higher speeds, over 440 ft./min. The more competent subjects at lower ambulation rates were working physiologically at 308 ft./min.; at higher speeds, 352 to 440 ft./min. In subjects with intact musculature, walking at 440 ft./min. presents no great stress and can be long maintained barring cardiorespiratory impairment; however, it must be recalled that, in paraplegics, the main contribution to muscular activity is by the relatively small muscle mass of arms. Assuming in a 70 kg. man a total muscle mass of 28 kg., in paraplegics the metabolic turnover is probably taking place in two-fifths to one-third of this total, even allowing for hypertrophy of the upper limbs. Calculated as metabolism per kilogram of muscle mass, an activity costing 5 M. U. would represent 0.25 M. U. per kilogram of leg muscle in normal men; in paraplegics, 0.45 to 0.52 M. U. per kilogram of muscle. The load is two times higher for the arms than for the legs, and for musculature ill adapted to bearing weight at that.

On the basis of activity per unit of muscle mass, similar levels of anaerobic work determine the appearance of lactacidemia both in normals and in our subjects. Well-trained athletes show excess lactic acid in the blood at the critical level of 2 to 2.5 L. of oxygen debt,[9] or 89 cc. per kilogram of muscle. (This value is probably higher as the total of 28 kg. of muscle did not contribute to the debt). It will be recalled that in our paraplegics an oxygen deficit of 700 cc. was associated with lactacidemia; therefore, at least the lower limit for the appearance of lactic acid would be 63 to 76 cc. per kilogram, a good agreement with the normal figure. This correspondence demonstrates that one of the limits to sustained physical activity (lactacid debt) is universally applicable to muscles of all limbs and operates in athletes and paraplegic individuals alike. It also indicates that the relatively smaller lactacid debt tolerated in paraplegics is only apparent.

Aside from the lactacid oxygen debts limiting ambulation on a practical basis, cardiovascular events must also be considered. As oxygen consumption rises, cardiac output is also augmented by the same degree, for a linear relationship exists between the two.[10] Assuming a normal volume output of 4 L. per minute, the stress upon the heart, particularly in the older age group, to maintain a flow of 16 to 28 L. per minute (4 to 7 times normal) must receive serious attention by practitioners.

Any device that tends to reduce this stress would be useful. Among the arguments advanced for or against minimal bracing, to our knowledge none has considered the influence of bracing upon energy requirements. Evidence has been presented which indicates that a mechanical component of proper bracing may be worth 1 M. U. saved.

Aside from the obvious inferences to be drawn from these findings in respect to cardiac and pulmonary disease, crutch ambulation has other metabolic implications in the field of rehabilitation. The lower limb amputee is commonly in the aging group. From the point of view of stress, along with other considerations of equal importance, a prosthesis is probably preferable to crutch ambulation. Exploration of the metabolic turn-over of ambulation in the amputee would be illuminating. Another problem is precise definition of the oxygen requirements of a swing-to as compared to a swing-through gait. Though slower, the former is probably less demanding and may be prescribed with more confidence in applicable circumstances were the metabolic cost known to be lower.

Summary and Conclusions

Oxygen uptakes and total requirements per minute, oxygen debts, efficiency, and blood lactic acid concentrations during ambulation were studied in 11 subjects with paraplegia caused by poliomyelitis, spinal cord injury, or brain damage. In ambulating by swing-through gaits at rates ranging from 88 to 282 ft./min., energy requirements per minute were found to be at least 3.5 times, and often 5.5 to 8 times, the basal rate. Both correlation of clinical findings with observed energy requirements and

analysis of alactacid and lactacid oxygen debts substantiate the fact that the ceiling for sustained paraplegic ambulation is between 5 and 6 M. U. of expenditure (5 to 6 times B. M. R.). Efficiency of progression is low; in metabolic terms healthy individuals for the same costs could walk 264 to 484 ft./min. The magnitude of energy costs at a given speed mainly reflected the degree of motor loss. Other significant factors appearing to affect costs unfavorably were increasing age and, particularly, inadequate bracing. All but two subjects, and these at low speeds of progression only, developed significant oxygen debts. Lactacid debts apparently occurred when oxygen debts rose above 700 cc. This depended mainly on the extent of disability and speed of ambulation, and always coincided with an expenditure of 6 M. U. The limited absolute capacity for anaerobic work in paraplegics depends on the small muscle mass of the arms but relatively approaches the athlete's tolerance. Paraplegic ambulation ranges from moderate to hard work and must be judiciously prescribed.

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Any member of the American Congress of Physical Medicine and Rehabilitation wishing to submit the name of an individual for consideration by the Gold Key Award Committee, may do so by sending such information to the Committee Chairman, Donald L. Rose, M.D., Dir., Dept. of Physical Medicine, University of Kansas Medical Center, Kansas City 3, Kansas.

Any nomination must be substantiated by the sponsor's opinion as to why this high award should be conferred on the individual so named.

The Relationship of Function to the Microscopic Structure of Striated Muscle: A Review

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Brooklyn, N. Y.

There are 434 muscles in the human body, which constitute 40 to 45 per cent of the adult body weight and amount to about 250 million individual muscle fibers. Seemingly simple activities like standing and walking demand coordination and organization of these fibers in a pattern which, together with their innervation, present a picture of such complexity that it defies imagination.

Muscle tissue that generates motion also generates tension. We are accustomed to deal with such expressions as isotonic concentric contraction, in which isotonic apparently stands for tension, concentric for direction, and contraction for shortening. We also deal with the expression isotonic excentric contraction, in which isotonic again stands for tension, excentric for direction and contraction — for what? We speak of isometric contraction. Here isometric apparently stands for dimension, which remains unchanged, and contraction necessarily for tension.

The dictionary defines tension as the act of stretching and as pertaining to stretch. Do we always use it only with regard to stretch? In our usage, is it capacity or spark? Moreover, in scanning the literature, from time to time, one encounters a sentence implying that stretch, elongation, or relaxation are the active motions of the muscle.

The microscopic structure of striated muscle and its relationship to contraction, stretch, and relaxation will be reviewed and discussed in this paper.

Muscle Structure

Grossly, muscle consists of fibers banded together, 20 to 100 or more, into a primary bundle. Several of these bundles form the secondary bundle, and a group of these secondary bundles, the tertiary bundle. Connective tissue that covers and holds together the larger bundles is called the epimysium, which sends sheaths of connective tissue between the secondary bundles, called perimysium, and this sends sheaths between the primary bundles. These latter sheaths thin out still further until a thin membrane remains, called endomysium. The connective tissue contains elastic fibers, mesodermal cells, blood, and lymph vessels, except for the endomysium, where the presence of lymphatics is still problematic.

The individual muscle fibers consist of three parts: the myofibril or sarcostyle which is the contractile matter; the sarcoplasma, within which the contractile matter moves back and forth, and the sarcolemma, the encasement of both.

The Myofibril

The principal cytoplasmic constituent of muscle fiber is the myofibril. There is a large number of them in each fiber, all longitudinally parallel and cross-striated. In vertebrates the fibril is 0.5 to 1 μ (micron) thick and seen in the ordinary light microscope consists of rows of dark and light bands, which account for the cross-striation in the fiber.

The dark bands are the Q bands (Querscheibe in German), the light are the J bands. These J bands are bisected by the Z membranes (Zwischenscheibe in German), which are of great importance as will be brought out subsequently. Of lesser importance is a line that bisects the Q band and is called the M line or Mittelscheibe.

A more lucid picture of these structures is obtained by observation in polarized light, where only substances that have the property of anistropism or birefringence may be seen to glow. Skeletal muscle possesses this quality. The dark Q band glows in polarized light, and therefore is called the anisotropic or A band. In polarized light, the J band becomes the dark band and is called the I or isotropic band.

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In order to avoid confusion, A and I will be the denominations most frequently mentioned here. The fibril therefore consists of a row of Z lines, half of an I band, half of an A band, an M line, the other half of an A band, half of an I band, and a Z line (fig. 1).

The Z line is supposedly densely adherent to the sarcolemma and built of more solid material. It lends stability to the structure, localizes damage to an area between the two Z lines, and helps in the transmission of impulses from the sarcolemma to the contractile matter.

Krause, as quoted by Adams, Denny-Brown and Pearson, has introduced the following concept of muscular structure: Myofibrils are built of discs arranged in coin fashion. Each disc consists of Z, half an I, a whole A, another half an I, and another Z. Such a section, called the sarcomere, is 0.002 mm. thick and 25 times as large in diameter.

Some authors deny the presence of such divisions. An oil drop has been observed moving up and down a myofibril for a distance longer than 0.002 mm. Teased apart, frog muscle fibrils contracted for quite a distance within the sarcolemmal sack. However, the existence of sarcomeres according to Krause has been generally accepted — the idea of compartmentation of the fibril into identical units with a common nerve and blood supply, where identical chemical processes occur simultaneously, as in a row of test tubes.

Chemically, micro-incineration of fixed striated muscle fibers has yielded a heavy white ash in the A band that contained calcium and magnesium and a light bluish ash in the I band that contained a larger concentration of potassium.

From ultraviolet microscopic studies, evidence has been adduced that adenosine compounds are concentrated in the I bands. In this experiment there was strong absorption in the wave lengths 2400 to 2950 Å. The substances in muscle that show absorption at this frequency are the purine derivatives such as adenylic acid and adenosine triphosphate. After strong contraction material diffused into the A band, and the latter became swollen.

Numerous attempts have been made to measure the sarcomere and its constituents during different states such as during rest, stretching, or contraction. It was found that during so-called rest, the A band measured 1.37 μ, and the I band 0.81 μ. During isometric contraction the corresponding measurements were 1.13 μ for the A and 1.05 μ for the I. The sarcomere remained constant in its length, but the A band shortened by

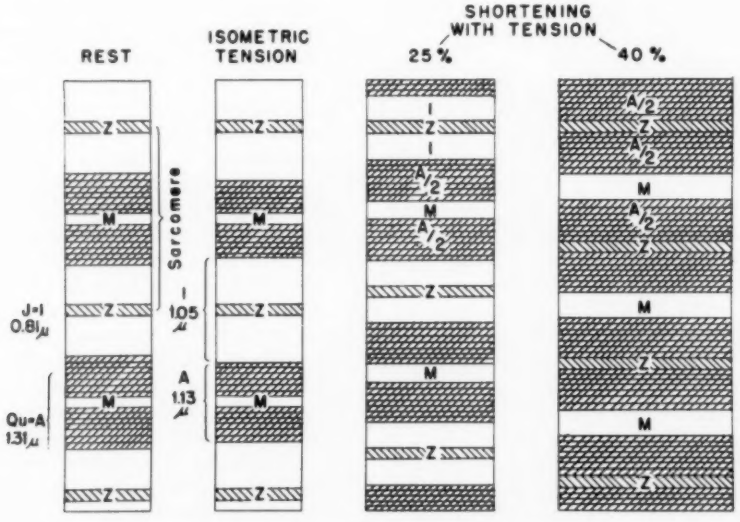

Fig. 1

18 per cent and the I band lengthened by 28 per cent.

During isotonic contraction the sarcomere shortens and the I band disappears. Its place is taken by a thickened and swollen A band.

Frog muscle fibers thrown into violent tetanic contraction shortened to less than 60 per cent of their length. In this case the stained fibers showed tightly packed half A,Z, half A parts. In the living muscle of the tadpole a tetanic contraction of the whole fiber was induced. The obliteration of the I band occurred when the fiber was shortened 40 per cent. If shortening of less than 25 per cent occurred, a relative narrowing of the I band resulted.

Assuming that these measurements are correct, then contraction consists of two parts, one dimensional and one tensional. The dimensional part may be fractional and so seems removed from the jurisdiction of the "all-or-none law." The tensional part stays within this law, using up maximally with each facilitation all available fuel.

Contraction literally means to draw together, to shorten. Since it encompasses both tension and dimension, at times it leads to seemingly contradictory expressions. For instance, in isotonic contraction it is used dimensionally, in isometric contraction tensionally. The use of the expressions "shortening under tension" and "tension in isometry" would obviate this contradiction in semantics.

In both concentric and excentric contraction, muscle fibers and fasciculi shorten under tension. But in concentric contraction the load is overcome and the muscle as a whole shortens, while in the excentric contraction, the load is the stronger, and the muscle as a whole lengthens in deceleration. "Shortening under tension" and "lengthening under tension" seem semantically clearer.

Nowhere within the fiber or fibril has a stimulus directly produced lengthening or stretch. A muscle fiber can only react with shortening. If stretch is desired, the stimulus producer, for instance the cortex, can do it only in a roundabout way — either by shortening the antagonist fiber (the sum total of agonist and antagonist must always be constant) or by exposing its lever to gravity, or by employing outside force.

Contraction is the only active motion which a stimulus can produce, be it cortical, or as we shall see later, myotatically reflex.

The Sarcoplasma

The sarcoplasma in the muscle fiber is the undifferentiated protoplasm in which the myofibrils are embedded. It is a viscous substance that causes adherence of the myofibrils.

In frog muscle, the amount of sarcoplasma is estimated to be about 40 per cent of the total volume of the fiber: However, the amount varies with the species, and with different muscles of the same species. The darkness or paleness of muscle fibers depends on its content of myohemoglobin. Darkness is associated with strength and endurance and the paleness with rapidity of action.

The distinction between dark and pale fibers does not depend on any nervous differentiation as one nerve fiber may provide endings for both kind of fibers. Denny-Brown has shown that in the muscle of a new born kitten the fibers were all dark, some becoming pale after a few weeks, an expression apparently of functional adaptation.

Within the sarcoplasma there are granules of different sizes and locations. Microanalysis has shown the larger ones to be neutral fats and the smaller ones lipoproteins. They have some refractivity. Some workers have thought that these granules could be responsible for the cross striation, but since some fibers are cross striated and hardly have any granules, and since in starvation these granules are greatly reduced, this theory has come to nought.

It is held that myogen, the albumin fraction isolated from whole muscle, is confined to the sarcoplasma. If this be true, then the sarcoplasma is not just a storage house for food, but has considerable metabolic function. From time to time the idea has been advanced that the sarcoplasma is actively engaged in contraction; however, evidence of sarcoplasmal contractility in mammals has been entirely lacking.

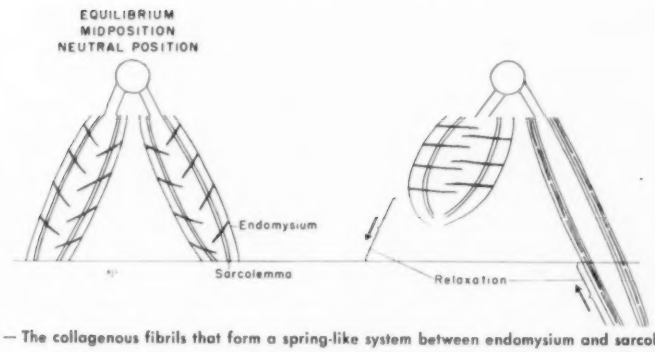

Fig. 2 — The collagenous fibrils that form a spring-like system between endomysium and sarcolemma.

The Sarcolemma

The sarcolemma, cell membrane, or inner cell membrane, when viewed in the electron microscope at a magnification up to 30,000x, is seen as a thin, structureless membrane of 20 to 100 Å thickness. It separates the potassium-rich inner ionic environment from the sodium-rich outer environment. The impulse travelling along the sarcolemma is accompanied by a disturbance of the ionic balance which gives rise to the action potential.

Several methods have been devised to make the sarcolemma visible, for example, by rupture of the fiber. In teased fibers, the sarcous part retracts producing "caps" and an empty air space remains. Stimulation with caffeine, nicotine, or galvanic current at the time of fixation will show the sarcolemma separated from the substance.

In intimate connection with the sarcolemma another structural element exists. This consists of a rich net of fibers surrounding the muscle fiber and adhering closely to the surface. The fibers of this net are 250 Å wide and cannot be distinguished in the ordinary light microscope. They have a tendency to unite and to form a continuous sheath. They must contribute greatly to the mechanical stability of the muscle and protect the semi-solid contractile matter and the thin sarcolemma from injury. From their structure, elasticity must be expected and the elastic properties of muscle observed on stretching must result from this fiber net to a great extent. These fibers are described minutely by Szent-Gyorgyi,[1] and Denny-Brown, Pearson and Adams[2] quote Nagel as follows: "The collagenous fibril bundles wind in spirals around the individual muscle fibers before ramifying and joining the endomysial sheath. The course of these fibrils and the distance between them varies according to the degree of contraction of the muscle. In the fully contracted state they are almost at right angles to the axis of the fiber and close together, while in the extended state they are nearly parallel to the muscle fiber." (See fig. 2).

During contraction these spring-like structures expand perpendicularly to the axis of a shortened and thickened muscle fiber. The stretching of the elastic fibers constitutes an investment of mechanical energy by the chemical process of contraction. At the same time, a fiber in the antagonist muscle has lengthened, for the sum total must remain constant. The elastic fibers around the lengthened antagonist muscle fiber have lengthened too, but parallel with the muscle axis. There, too, the contracting fiber has invested mechanical energy in a spring-like structure.

Implications of these spring-like structures are that a bouncing or recoil effect upon reversal of motion exists, making the reversal smoother and faster. Upon cessation of impulses, a return to a resting state occurs; this is a theoretical neutral state. The expenditure of the above mentioned mechanical energy could be called true "relaxation" and active motion.

Nerve Supply

Half of the muscle nerve consists of efferent fibers and half of afferent (fig.

3). The efferent fibers are of two kinds. One, more heavily myelinated, comes from the anterior horn cell and is one part of the lower motor neuron. One anterior horn cell and its axon may serve 10 to 200 muscle fibers. The axon, which is embedded in the sheaths of the muscle and in the epimysium and perimysium, branches and forms bundles of nerve fibers of its own that subdivide until one single motor nerve fiber enters one single muscle fiber. "Enters," however, does not mean that the nerve fiber pierces the sarcolemma. Micro-electrodes piercing the sarcolemma and carrying an impulse beneath the sarcolemma produce only a limited contraction. The nerve fiber does not pierce the sarcolemma. It ends epilemmal in the end plate, which is elevated and contains many nuclei. From there the impulse travels along the sarcolemma and the Z line to be evenly applied all over the fiber. Thirty per cent of the efferent fibers are smaller and poorly myelinated. These supply the intrafusal muscle fibers of the spindle and will be discussed shortly.

The afferent fibers of the muscle nerve are composed of fibers derived from the muscle proprioceptives. These are the spindles, tendon organs of the Golgi type, Golgi Mazzoni organs, and pain sensitive free nerve endings.

Muscle Spindles

Muscle spindles are located in the perimysium, along fibers of the fascicle, evenly distributed in all striate muscles. They vary in size from 0.5 to 3 mm. and consist of a fusiform connective tissue capsule within which one or more specialized striated muscle fibers are embraced by complex sensory receptors. These specialized muscle fibers are of small diameter. The part within the spindle is called intrafusal, the part outside the spindle is called extrafusal. Some authors, however, call them intrafusal in their entirety, in contrast to the ordinary fibers, which they call extrafusal. In this discussion, the latter terminology, in which the specialized fibers are called intrafusal in their entirety is used. These run parallel with the ordinary fibers either to connect with the aponeurosis or sometimes to connect with the extrafusal fibers directly. Within the spindle the intrafusal fibers are separated from the capsule by the so-called periaxial space, a space that is injectable through the perineural spaces in the nerves, according to Sherrington.

Each intrafusal muscle fiber has at least one endplate, some two. Innervation is supplied by the small efferent fibers mentioned previously which are derived, in all probability, from independent small nerve cells in the anterior horn of the spinal cord. These efferent nerve fibers, supplying the intrafusal fibers of the spindle, constitute the "small nerve fiber system." Each of these small nerve fibers seems to innervate several spindles; conversely, each spindle receives branches from more than one nerve fiber.

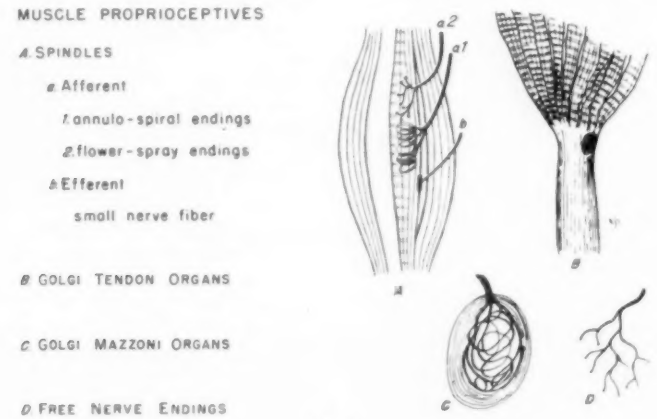

Fig. 3

Muscle spindles are peculiarly resistant to disease. Intrafusal fibers are therefore prominent in sections of atrophic muscle, whether from neurogenic or myogenic atrophy, even after all the surrounding muscle fibers have been reduced to sarcoplasmic threads. In such cases, spindles occasionally have been mistaken for parasites.

Afferent fibers coming from the spindle are of two kinds: Annulospiral endings, and flowerspray endings. Annulospiral endings, which consist of neurofibrillar coils applied to the intrafusal fiber, are excited by stretch. Flowerspray endings, which consist of separate endings for each fiber, are excited by contraction of the intrafusal fibers and spindle.

Tendon organs of the Golgi type are encapsulated structures situated at the junction of the extrafusal muscle fibers with an aponeurosis. Each tendon organ gives rise to a single nerve fiber. These organs are responsive to tension on the attached extrafusal muscle fiber group. The tension produced by active contraction is more effective than that produced by passive stretch.

Golgi Mazzoni corpuscles are small encapsulated endings similar to those found in the pleura, mesentary, and the deeper layers of the dermal tissues. They contain a branched and coiled central nerve expansion, and are found in most tendon sheaths, aponeuroses, and intramuscular septa and periosteum. It is assumed that they, too, respond to stretch.

Free nerve endings are pain receptors similar to those found elsewhere in the body. In the muscle they are chiefly in the adventitia of the blood vessels, in the aponeurosis or in the endomysium. They respond to stretch and to pressure.

Any pull or stretch exerted upon the intrafusal fiber and the spindle will be transmitted from the annulospiral endings, via the heavily myelinated nerve fiber (the A fiber), the two motoneurons, and the monosynaptic reflex arc to the muscle fibers, producing a reflex shortening, the myotatic reflex. Interruption by one syapsis only, the heavy myelination, and the relatively high conduction velocity make this the fastest reflex contraction of all. It is able to escape for a tiny fraction of time the vigilance of the cortex; however, the cortex must activate the small nerve fiber system and the spindles.

The response of the spindle endings is subject to an interplay of the effects of external stretch and of small nerve excitation. Thus, when the muscle is slack, intrafusal fiber activation has little effect on the sensory discharge. As external tension is applied to the muscle, the resultant stretch deformation of the sensory ending will cause it to discharge, and in addition, small nerve excitation will be more effective in producing an increment in the discharge.

Small nerve control of spindle activity is probably most important in sustained muscle contraction associated with little shortening, such as occurs in the maintenance of postural attitudes.

Comment

The cortex "turns on the ignition" facilitating muscle shortening and at the same time activating the spindles "in parallel", keeping the myotatic reflex in readiness (fig. 4). Any pull during this stage, or any resistance, whether it is the therapist's biceps or a load (and the stretch need only be 0.05 mm.), will activate the annulospiral ending and cause a response by the myotatic reflex. Tonus, locostation, and locomotion, which are similar in principle, all being load against gravity, depend upon this myotatic reflex. Tonus restores minimal lost balance between agonist and antagonist fiber, locostation maintains standing by restoring somewhat larger loss of balances, and locomotion regains much more obvious loss of balance.

Lifting a heavy load constitutes a continuous pull upon the spindles, which is a summation of many individual pulls. The response is a summation of myotatic reflexes for production of strength, in a concentric direction for lifting, or in an excentric direction for setting down a load. This principle is also used in progressive resistance exercises.

The cortex is able to provoke the myotatic reflexes in muscles under its command by exposing their levers to gravity or to resistance of the muscles antagonists. While the cortex is un-

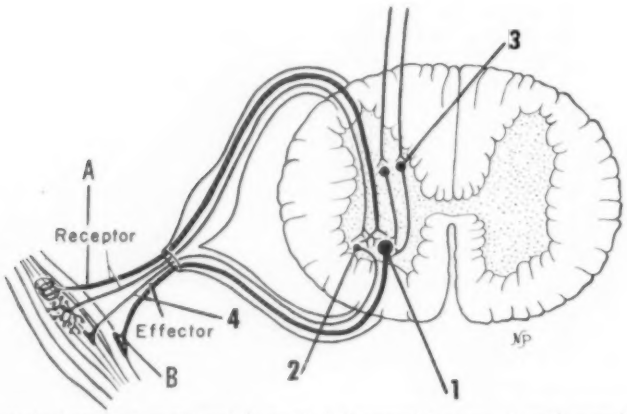

Fig. 4 — 1, anterior horncell; 2, small tough horn cell; 3, internuncial neuron; 4, small nerve fiber; A to B, monosynaptic reflex arc.

doubtedly the master of initiating volitional motion and the controller of all, it needs the help of the myotatic reflex and its very limited but important autonomy for the checks and balances of everyday life and for the production of strength.

Summary

The only active, chemically induced motion is contraction. Contraction consists of a tensional and a dimensional part. Relaxation is caused by mechanical energy of elasticity. Elastic fibers constitute a springlike system with various functions. Stretch and lengthening of muscle fibers are induced indirectly. Myotatically induced reflex contraction is essential for tonus, locostation, and locomotion. The muscle spindle is essential for the myotatic reflex. If adenosin triphosphate can be called the master substance in human muscular activity then the myotatic reflex is the master motion and the muscle spindle the master key.

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Appraisal of Patient Goals in a Community Rehabilitation Center

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Akron, Ohio

With emancipation of medicine from an era of limited and nonspecific treatment to an era of dynamic therapy with specific biologicals and early mobilization, community rehabilitation centers will tend to flourish as complete medical care takes firmer root in community life. A positive effort has been made in Akron, Ohio by the establishment of a well-equipped center with an alert board of trustees in affiliation with the United Foundation of Akron, the United Campaign Agency.

The staff of this organization from its inception has included a full-time director who is a physiatrist, a full-time rehabilitation counselor who is a psychologist and a vocational counselor, and the three service divisions — physical, occupational, and speech and hearing. The Rehabilitation Center of Sumit County, Inc., admitted 632 new patients ranging in age from 3 months to 82 years, during its first year of operation. Approximately 38 per cent of the patients paid full fees; 27 per cent paid reduced or no fees; fees of 38 per cent were paid by 38 different public and private agencies. Out of about 400 physicians in Akron and vicinity, 193 different physicians referred patients to the center in its first year. Admissions are only by referral from a physician, a recognized clinic or a hospital. These patients represent all strata of economic and social life; approximately 65 per cent were considered private patients who had no connection with a public or private welfare or social agency.

Since the Rehabilitation Center of Summit County, Inc., has had experience unique in many ways as a truly community facility servicing all ages and economic strata, and since many other communities are considering the establishment of a rehabilitation center, it seems worthwhile to discuss the appraisal of patient goals in a community rehabilitation center.

Rehabilitation Goals

Dr. Howard Rusk has cited the following as goals of rehabilitation: self-care, homebound employment, sheltered shop employment, and part-time or full-time employment outside the home.

In a study of 476 patients who had completed rehabilitation at the Institute of Physical Medicine and Rehabilitation in New York, Rusk and McCoy,[1] concluded, "resources and potentialities of the patient on admission as reflected in the prognosis were factors of some weight in rehabilitation but they were not controlling factors." They also suggest a further exploration to identify characteristics of patients in order to prognosticate accurately the therapy and thereby the goals.

Ability to prognosticate results of treatment in physical medicine and rehabilitation will not result in exclusion of patients who require aid, but rather will permit the physiatrist to be confident through knowledge, diagnostic acuity, clarity of prescription, and recognition of therapeutic results.

Report of a Study

Statistics on 139 patients discharged by the rehabilitation center in Akron have been compiled. These patients were of the general rehabilitation group, chosen at random among those discharged prior to May 1, 1955. The medical director and the therapists, or other members of the staff concerned with the patient, appraised the patient independently on the basis of the following four questions:

1. Do you consider that the patient's rehabilitation was highly successful, moderately successful, or not successful?
2. Was he (or if under 10 years of age, the family) highly motivated, moderately motivated, not motivated?
3. Would you have stopped this pa-

Read at the Thirty-third Annual Session of the American Congress of Physical Medicine and Rehabilitation, Detroit, September 1, 1955.

Director, Rehabilitation Center of Summit County, Inc.

tient's treatments earlier, later, or at time of discharge?

4. Do you think that the patient could have done more than he learned to do?

All the possible statistics have not been tabulated. For brevity, the appraisal of members of the staff are averaged; further, rehabilitation was considered to be either successful or unsuccessful, the patient to be either motivated or not motivated. Successful rehabilitation is here defined as the attainment of functional activities that were not previously performed; the patient was his own standard. The larger economic goals of employment were not considered.

The attainment of a rehabilitation goal depends on preparation and training of the patient, his personality, inter-relationships of the patient and therapists, and physical environment.

Preparation and Training: Preparation by the referring physician for the rehabilitation part of total medical therapy may instill in the patient valid hope for the future, false hope, or futility. Knowledge of total prognosis may influence a patient's receptivity on admission depending upon his personality. In our study, persons referred by physicians seemed to respond more favorably to physical treatment, regardless of duration of disability or of personality traits (table 1).

Table 1: Correlation of Source of Referral with Success in Rehabilitation

Referral Source	Total Patients	Rehabilitated
Self	38 (27%)	23 (61%)
Agency	28 (20%)	12 (43%)
Physician	73 (53%)	62 (85%)
Totals	139	97

Full knowledge of the patient's medical status will aid in determining his personal goal. The best previous medical care may permit only limited goals, but a prepared patient has a greater chance of being raised to his optimum functional status if his endowments are given due consideration.

Personality of the Patient: The "personality" of the patient includes age, sex, education, intellectual endowment, and economic and personal characteristics. McCoy and Rusk place little significance upon these factors, although in an isolated statement they pointed out that women in a "comfortable economic status" were found to be among the poorest rehabilitation risks.[1] In our study greater success was observed with patients between the ages of 20 and 50 years (table 2). The low success rate in children under 10 years of age is partly explained by the fact that many of them were physically and mentally retarded or had cerebral palsy. Long-term disability associated with arthritis and cerebral vascular accidents accounts for most of our patients over 50 years; in this group also response was less successful. Rusk claims good rehabilitation rates in 71 per cent of patients under 35 years of age and only 40 per cent in those over 35. He also noted a dip in successful response to treatment in the 35 to 44 age group. He reported on only two patients under 15 years of age.

Table 2: Correlation of Ages and Success in Rehabilitation

Age Groups	Total Patients	Rehabilitated
Under 5 years	13	7 (54%)
5-10 years	9	4 (44%)
10-20 years	17	10 (59%)
20-30 years	11	10 (91%)
30-40 years	16	10 (63%)
40-50 years	25	20 (80%)
50-60 years	19	10 (52%)
over 60 years	29	16 (55%)

Insufficient data were available to determine the success of therapy on the basis of I.Q. Our data on education of the patient, which reflects I.Q., show that the more educated an individual is, the less successful results tend to be (table 3). Rusk's chart showed a reverse tendency.

Table 3: Correlation of Education and Success in Rehabilitation

Education Level	Total Patients	Rehabilitated
None	2	2 (100%)
Partial Elementary	16	11 (70%)
Eighth Grade	14	13 (93%)
2 or more years of High School	37	25 (68%)
2 or more years of College	17	10 (57%)

Our data also suggests that in a com-

munity where all persons are given an opportunity for rehabilitation, fee-paying contributes to a better rehabilitation prognosis (table 4).

Table 4: Correlation of Fee Payment and Success in Rehabilitation

Source of Fee	Total Patients	Rehabilitated	Considered Not Motivated
Private ...	73 (53%)	50 (68%)	14 (19%)
Agency ...	66 (47%)	37 (56%)	21 (32%)

Grayson, Powers, and Levi[2] observed that patients who made 60 to 100 per cent anatomy responses on Rorschach cards had difficulty in treatment; none reached maximum physical potential. They further observed that a neurotic personality structure showed maximum progress in rehabilitation. In a group of 29 of our more severely disabled patients given Rorschach evaluations, 13 patients rejected one or more cards. This group included hemiplegics and patients with poliomyelitis, muscular dystrophy, and multiple sclerosis. This rejection of cards indicates an unwillingness to deal with a situation or to become involved with others. This tendency to stand on the fringe of life appears to become a part of the pathology of any chronic disability. The metamorphosis from a benign lesion of initial emotional overlay to a spreading growth of mental depression, which tends to overshadow the primary disability, seems to occur about 6 to 12 months after the onset of the disability. What is more significant, it appears to be irreversible. This malignant complication thus immediately limits the goal of a potential rehabilitant. Technics and devices of motivation may be temporarily successful during the course of treatment; however, because the patient basically declines to participate aggressively in the entire program of rehabilitation, the over-all success of rehabilitation efforts in his behalf is negligible. Nonetheless, in a community rehabilitation center, a reasonable trial of therapy is warranted.

Patients with amputations achieved greatest success in our series, 90 per cent returning to full employment or school. This may be misleading as 75 per cent of these amputees were selected cases that were referred by the Bureau of Vocational Rehabilitation. Our largest single group of disabled people, constituting 14 per cent of our total admissions in 1954, had cerebral vascular accidents resulting in hemiplegia. Their ages ranged from 38 to 82 years of age; average was 58.5 years. Their over-all highest status of performance was ambulation and self-care at home, and was achieved successfully by 60 per cent of them. Only 14 per cent of our hemiplegics went to full employment.

Table 5: Correlation of Type of Disability and Success in Rehabilitation

Type of Disability	Total Patients	Rehabilitated
Amputation	12	10 (83%)
Cerebral vascular accident	34	21 (62%)
Arthritis	16	10 (63%)
Cardiac disorder	1	
Cerebral palsy	17	6 (35%)
Fracture	8	6 (75%)
Muscular dystrophy	4	2 (50%)
Orthopedic problem	18	15 (83%)
Multiple sclerosis	7	2 (29%)
Peripheral nerve and spinal cord injury....	5	3 (60%)
Poliomyelitis	17	13 (77%)

Interrelationships of Participant with Staff Members: The affect of interrelationships of patient and individual members of the rehabilitation staff has not been carefully analyzed. Does the relationship, if not amicable and positive, create lack of interest or frequent absenteeism? In order to anticipate a patient's response in therapy is it necessary to assign a particular therapist to the patient because of responsive personality relationships? Although we have no statistics for sociability, the Rorschach evaluation gives some indication of interrelationships. It is our impression only that a sociable patient is a successful rehabilitant.

Home Environment: The environment of the patient at home can promote or impede progress in therapy. Domineering parents, disinterested parents, or unintelligent parents afford a passive or reactive environment wherein all positive efforts within the center are negated, particularly for children and adolescents. As an outpatient facility we depend on carryover of definite activities in the

home so that during the rehabilitation process increments of self-care become incorporated in normal daily activity. This is a distinct advantage, in many cases, over the sudden change that takes place when a patient departs from the home at one level of performance then returns at another level. With the patient returning home daily, the rehabilitation center staff has an opportunity to counsel the family regarding stages of progress toward independence and can work out physical changes in the home as they occur. Too little is done in this direction.

Conclusions

An individual goal is determined for the patient within the framework of the larger goals of rehabilitation. In our center, two goals are established for each patient on admission: a functional goal and an employment goal. Functional goals are self-care, increased use of hands, conversational speech, hearing for employment, wheelchair existence, and ambulation with or without appliances. Employment goals are housekeeping, sheltered shop employment, and partial or full employment outside the home.

Functional and employment goals are estimated initially on a pathophysiological basis. It is felt that these medical goals can be modified by nonmedical factors. Nonmedical factors, based upon our observations, are fee-payment, age, referral source, time of disability, education or mentality, emotionality, home environment, and sociability. The ideal patient, according to our statistics and observations, is a fee-payer, between the ages of 20 and 50 years, referred on the initiative of his family physician. He has had good previous medical care and short-term disability. He has had a grade school or high school education or is of average intelligence. His home and family environment are responsive and he is sociable.

Each nonmedical factor that is favorable to the patient is given a plus sign; if certain factors appear to fall outside of these bounds then a minus sign is ascribed. If a summation of the plus and minus signs shows a predominance of minus signs, the patient will probably not meet the expected medical level of achievement. If the nonmedical factors are largely favorable, as indicated by a predominance of plus signs, the patient will probably meet or even exceed expectations.

Summary

Data have been presented which indicate that nonmedical factors modify the rehabilitation goal based on medical prognosis. A rule of thumb, which considers a rehabilitation prognosis in light of both medical and nonmedical factors, is suggested to guide the physiatrist. As community rehabilitation becomes specific and meaningful the more indispensable to the community will this medical service become.

References

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2. Grayson, M.; Powers, A., and Levi, J.: Psychiatric Aspects of Rehabilitation, Rehabilitation Monograph II, New York Institute of Physical Medicine and Rehabilitation, New York University-Bellevue Medical Center, 1952.

Editorial

Relationships of the Physiatrist Within the Medical Profession

Every innovation or change in any profession requires some change in the attitudes of all members of that profession. This is especially true of the medical profession. Even though the healing arts have undergone vast changes in the past few decades, and now at a rate never before known, yet orientation tends to lag behind. There is inertia, even open opposition to the inclusion of technics in medicine which have been proven of great value. Persons associated with the new methods are also apt to be held suspect by the medical fraternity, until their methods and place in the healing arts have been established and accepted. The physiatrist is presently in the position of a newcomer in the medical flock, at times accepted, often suspected, or occasionally put upon by his confreres as an unwelcome invader.

The need for specific knowledge and the need for skills and technics not readily available have brought about the development of all the present medical specialties. The justification for the existence of any specialty lies in the performance of needed services in a special area of medicine.

For example, the pathologist has achieved his present unique distinction in little more than the past two decades. His is a specialty of service. He has done a very great deal to raise the standards of medical practice, and to safeguard profession and public alike. He supervises the work of all the technicians in his laboratories, in behalf of both patients and doctors. His work is chiefly diagnostic and evaluative, but it has direct bearing on treatment. With every test which a doctor requests there is always a consultative relationship with the pathologist.

The radiologist of today, likewise, has become a most respected specialist, serving all other physicians in application of x-radiation to diagnosis and therapy. Every request for roentgenologic examination or treatment is a request for a consultation with the radiologist. Not long ago the director of the x-ray department was expected to supervise the administration of all the rest of the electromagnetic spectrum, plus electro-therapy. He was, in part, the director of physical therapy as well as of radiology.

Physical medicine is now separate from radiology by reason of the need for the present division of service and interest. Many elements foreign to radiology were added to physical medicine. As the need for special knowledge and medical supervision of therapists grew, the specialty of physical medicine took shape. This development was fostered by the American Medical Association through the active interest of the Council on Medical Education and Hospitals, and of the Council on Physical Therapy, from the time of its establishment in 1925. Research was fostered, courses in medical schools encouraged, and false or exaggerated claims exposed. Study and official acceptance of electro-medical apparatus and many other devices clarified physical medicine to the entire medical profession.

The American Board of Physical Medicine was officially established in June, 1947. The Council of the American Medical Association, the armed forces and the Veterans Administration, the

Baruch Committee and the National Foundation for Infantile Paralysis all gave impetus to the development of the specialty and encouraged the formation of the new Board. In 1949 the name was changed to The American Board of Physical Medicine and Rehabilitation. A specialist in physical medicine was first officially designated as a 'physiatrist' in 1946, the word being derived from 'physis' or physics, and 'iatros' meaning physician.

With the new Board and the new name for the physiatrist a great need for better orientation of the rest of the medical profession toward both became apparent. Neither the term nor the doctor designated by it have been fully accepted. This presentation is offered to all physicians as an attempt to expedite the process of orientation.

Basically, physical medicine and rehabilitation constitute a *service* to the entire medical profession. This service includes diagnostic, evaluative and special therapeutic procedures, and entails use of much special equipment and often a team approach which is strange to many doctors. The employment of physical equipment, such as the oscilloscope, the ergo-graph, or flow meter requires special training, as do diathermy, the microtherm or ultrasound generator. Costs, extra space and need for trained therapists preclude the use of any large variety of physical procedures in the average physician's office. The alternative is to omit or ignore indicated physical measures. Some doctors have relied on directions for home treatment, but these are notoriously unproductive of results unless preceded by teaching, drill, and then checking of the procedures by a therapist and the doctor. Accurate performance of exercises is more difficult to secure in a home situation than adherence to a diet at home. Detailed exercises, the long training and conditioning of chronically disabled patients is simply too time-consuming for the average busy practitioner to supervise adequately. Delegation of this part of his responsibility is certainly preferable to default of it.

Adequate medical direction of therapists requires time, close acquaintance with physical technics, and frequent observation of the patients undergoing treatment. The relation of the physiatrist to the therapists must be that of an understanding fellow worker, mentor and advisor, a sort of symbiosis. It is contrary to medical ethics for a department of physical medicine to be without 'adequate medical supervision', either by a physiatrist or some other physician. When a therapist is asked to work out the details of a plan for treatment of a patient, with little more than a signal to 'start therapy' the physician who makes such a vague request is, in effect, asking the therapist to function as a quasi-doctor, to supply detail which is the physician's responsibility. Conscientious therapists hesitate to assume such responsibility. Both ethics and the law place responsibility upon the physician to furnish or secure adequate medical supervision of therapists, technicians or others who assist him in the medical, surgical or physical treatment of his patient.

Physical medicine pervades all fields of medicine, and the physiatrist serves physicians in all the other specialties and general practice. The principles of biophysics are as pervasive in medicine as are those of bio-chemistry. Because of the wide spread of physical medicine, it is most necessary for the physiatrist to have the broadest background in all phases of medicine and surgery, in order that he may best understand the wide variety of problems in which his help is asked, and to gain and hold the respect of his confreres. His sense of ethics must be most vivid, and his diplomacy above average, since each transaction of any staff physician with the physiatrist has the elements of a consultation, be it ever so informal.

If the physician who asks for services in physical medicine has some knowledge of indications and procedure, and specifies these in adequate detail, the physiatrist is able to assure that therapy will be exactly as prescribed. If orders are indefinite, incomplete or equivocal, the best interests of everyone require orders to be clarified and specified correctly. Communication between physiatrist and referring physicians should be adequate and quick, to avoid any misunderstand-

ing which might interfere with the best of medical care. Such a relationship can be entirely free of concern for prerogatives, and is in no way exclusive of the referring doctor, but protective and inclusive.

The personal sharing of the referring physician in staff conferences about rehabilitation cases is especially desirable; without him some key point may be missed in this team discussion which is so central to rehabilitation. The physiatrist needs the full confidence and collaboration of every physician who sends a patient for specific rehabilitation. Such a participation of the referring physician often is taken for granted but all too often has not been evident in practice. A better understanding of the place and function of the physiatrist should result in greater collaboration in this phase of medical care by general practitioners and specialists alike.

Encouragement of young physicians to specialize in physical medicine is essential to healthy growth of the specialty and of medicine as a whole. There is nothing in this thought to imply that the physiatrist has any monopoly of physical apparatus or technics. To the contrary, any physician is at liberty to equip a department, hire therapists and direct them. Growth of this specialty should improve and expand the use of physical methods by all physicians. There is a great and growing demand for dependable services in physical medicine and rehabilitation throughout the world, and a young doctor who chooses this specialty can expect a gratifying professional success, either in an institution or in a referral practice.

It is to be hoped that every physician who is in any way identified with physical medicine may so conduct his practice and inter-professional relations that he may contribute to growth of respect for the specialty and for the physiatrist. It is further to be hoped that each can help to establish proper relationships between the physiatrists and the rest of the medical profession, by exercise of skill in the technical phases of the specialty and the maximum of tact. Physical medicine will thus be firmly identified with the best of medical practice through recognition of the physiatrist as a needed and welcome collaborator with all other physicians within the ethical pattern, and in the best traditions of the healing art.

Arthur C. Jones, M.D.
Portland, Ore.

WHAT?

34th Annual Scientific and Clinical Session

WHEN?

September 9-14, 1956

WHERE?

The Ambassador, Atlantic City, N. J.

It's not too early to plan for this important meeting!

CORRESPONDENCE

ACPM&R Opposes Appointment of Doctors of Osteopathy

The following letter, opposing appointment of doctors of osteopathy in the Medical Corps of the Army and Navy, was sent to Senator Stuart Symington (D., Mo.) by the Congress Committee on Legislation:

February 14, 1956

The Honorable Stuart Symington
Senate Office Building
Washington, D. C.

Dear Senator Symington:

The American Congress of Physical Medicine and Rehabilitation is a national organization of physicians whose interests are primarily in the field of physical medicine and rehabilitation. The organization wishes to express its opposition to HR 483, an act to amend the Army-Navy-Public Health Service Medical Officer Procurement Act of 1947 so as to provide for appointment of doctors of osteopathy in the Medical Corps of the Army and Navy.

It is recognized by the American Congress of Physical Medicine and Rehabilitation that the practice and teaching of osteopathy has changed in many respects since its founder, Andrew Still, stated that the fundamental principles of osteopathy are different from those of any other system and the cause of disease is considered from one standpoint, viz., disease is the result of anatomical abnormalities followed by physiological discord, and to cure disease the abnormal parts must be adjusted to the normal; therefore, other methods that are entirely different in principle have no place in the osteopathic system.

In spite of the fact that in addition to the courses dealing with the principles and practice of osteopathy and osteopathic manipulative therapy, the osteopathic schools list the subjects included in the medical curriculum, it is still contended as originally enunciated by Still, that osteopathy is a complete and independent system of healing, representing not only a difference in the method of treating disease but a fundamental difference in principle, or conception of the causation of disease. This is cultist healing.

As applied to medicine, a cultist is one who in his practice follows a dogma, tenet or principle based on the authority of its promulgator to the exclusion of demonstration and scientific experience. It is recognized by the medical profession that manipulation may be of great benefit in certain conditions which respond to manipulative treatment, whether given by a properly trained physician, physical therapist, or osteopath. However, osteopathy does not restrict its therapeutic claims to those conditions which are known to respond to manipulation, but rather has attempted to erect a new theory of health and disease on imaginary pathology and unproven physiological hypotheses. Until the osteopaths state they no longer adhere to their theories of the causation of disease and method of treatment, osteopathy must continue to be considered as a cult.

It is realized that the teaching and practice of osteopathy has changed considerably in the past forty years. The training of osteopaths resembles in subject-matter that of doctors of medicine, so that in spite of their cultist theories, osteopaths do practice medicine. However, the training received is inferior in quality to that received by doctors of medicine, and osteopaths are not qualified as are doctors of medicine for the practice of medicine. Thus, osteopathy represents in reality a group of sub-standard medical practitioners.

It is the position of the American Congress of Physical Medicine and Rehabilitation that the appointment of doctors of osteopathy in the Medical Corps of the Army and Navy is unwise and will be detrimental to the Corps. The presently established high standards of medical care offered by the well-trained and highly qualified officers of the Medical Corps to the personnel of the Armed Services make undesirable the existence within the Medical Corps of any group of sectarian practitioners whose training and qualifications are of a lower order than the other officers of the Corps and whose presence would tend to dilute the quality of medical care available to military personnel.

Very truly yours,

AMERICAN CONGRESS OF PHYSICAL MEDICINE AND REHABILITATION
Glenn Gullickson, Jr., M.D.
Chairman, Committee on Legislation

UNITED STATES SENATE
Committee on Armed Services

February 16, 1956

Dr. Glenn Gullickson, Jr., Chairman
Committee on Legislation
860 Mayo Memorial Building
University of Minnesota
Minneapolis 14, Minnesota

Dear Dr. Gullickson:

Thank you for your letter of February 14, expressing your views on H. R. 483.

As Chairman of the Subcommittee concerned with this bill, I conducted a hearing on February 14, and expect to hear some additional witnesses as well.

Both sides of this issue were presented at the hearing. I appreciate having received your thoughts on this matter.

Sincerely,
Stuart Symington

AMERICAN MEDICAL ASSOCIATION
Washington Office,
1523 L Street, N. W., Washington 5, D. C.

March 3, 1956

Glenn Gullickson, Jr., M. D.
Chairman, Committee on Legislation
860 Mayo Memorial Building
University of Minnesota
Minneapolis, Minnesota

Dear Doctor Gullickson:

I very much appreciated your letter of February 29, enclosing a copy of a letter sent to Senator Symington and Senators Russell and Smith, expressing the opposition of the American Congress of Physical Medicine and Rehabilitation to H. R. 483.

Your excellent factual letter should be of great help to these senators in their consideration of this legislation. I am sure that they will be glad to have this information. I would suggest further that if you have any officials of your organization who are constituents of, or personally acquainted with, these senators or those on the attached list of members of the Senate Armed Services Committee, it might be very helpful to these members of the Congress if they would hear from your people on this matter.

I feel sure that if all the facts are honestly presented, the Senate will not hasten to approve this bill.

With best regards.

Cordially yours,
Thomas H. Alphin, M.D.
Director

AMERICAN MEDICAL ASSOCIATION
535 N. Dearborn Street, Chicago 10, Illinois
Committee on Legislation
R. G. Van Buskirk
Executive Secretary

March 5, 1956

Glenn Gullickson, Jr., M.D.
Chairman, Committee on Legislation
American Congress of Physical Medicine and Rehabilitation
30 North Michigan Avenue
Chicago, Illinois

Dear Dr. Gullickson:

I am writing to thank you for your letter of February 29, transmitting a copy of the communication submitted by the American Congress of Physical Medicine and Rehabilitation to the Senate subcommittee considering legislation which would authorize the commissioning of osteopaths as medical officers in the Armed Forces.

On behalf of the Committee on Legislation, I should like to express our appreciation for your interest and action in this matter. Too often, witnesses for the American Medical Association are charged with speaking only for some obscure hierarchy and not for the body of medicine. Actions such as your Congress has taken are the most effective manner of refuting this charge when the voice of medicine is raised in unison on subjects which affect patient care. Our representations in Washington are much more effective.

Thank you again for advising me of your action.

Sincerely yours,
R. G. Van Buskirk

Statement: H. R. 7225

Senate Hearing

Frank H. Krusen, M.D., Chairman of the Committee on Public Relations, represented the American Congress of Physical Medicine and Rehabilitation at the hearing conducted by the Senate Committee on Finance relative to H. R. 7225, Social Security Amendments.

STATEMENT
Re: H. R. 7225, 84th Congress
Social Security Amendments
Before Senate Committee on Finance
United States Senate
by
Frank H. Krusen, M.D.
February 9, 1956

Mr. Chairman and Members of the Committee: . . .

I should like . . . to discuss with you, from the standpoint of one interested in medical and vocational rehabilitation, the objections which I see to the enactment of H. R. 7225 in its present form and an alternative plan, which I believe will more fully serve the handicapped people of this nation.

Objectons to the Enactment of H. R. 7225

1. There has not yet been time to develop new phases of the already established Social Security program which give promise of much more effective service to disabled persons than the mere pensioning of them.

2. H. R. 7225 provides no truly effective means of *first* attempting to restore a disabled person to self-sufficiency, and *then* being certain that this is impossible, and that he is truly totally disabled. There is still a general lack of appreciation of the effectiveness of modern methods of rehabilitation. Rehabilitation has been defined as the restoration through personal health services, of handicapped persons, to the fullest physical, mental, social, and economic usefulness of which they are capable; the personal health services include both ordinary treatment and treatment in special rehabilitation centers. . . .

It was my privilege to serve first as Director, and later as Chairman, of the Baruch Committee on Physical Medicine and Rehabilitation, which was influential in initiating the development of rehabilitation centers throughout the United States, but the full potential of such centers of physical medicine and rehabilitation is far from being achieved. Every state in our Union now has an office, bureau, or division of vocational rehabilitation, with which the Federal Office of Vocational Rehabilitation works in close cooperation, but once again, because of shortages of vocational counsellors and other personnel, these units, though expanding rapidly, are still a long way from achieving their full potential.

In my opinion, our federal legislators should be encouraging continuing support of the enormous potentialities of these dynamic programs for rehabilitation of the disabled through the Federal Office of Vocational Rehabilitation, rather than encouraging the provision of pensions for the disabled. The full force of legislative action should then be directed, first, toward the dynamic rehabilitation of the disabled, and only after it has been found that it is impossible to rehabilitate an individual should legislative consideration be given to means for providing him with financial assistance.

3. Determining . . . that a person actually is totally disabled and incapable of being rehabilitated is going to be extremely difficult. No hasty legal enactment should be undertaken until a commission has studied this problem. [This] determination . . . involves not only a physical examination to reveal various disease processes and impairments of bodily function, but also innumerable psychological and emotional factors, including such intangible factors as motivation of the individual, will power, and character. Many persons having undoubtedly severe handicaps are supporting themselves and their families in gainful occupations. Other persons who do not have the proper incentives and motivations are being supported in idleness on the public assistance rolls, when they have much less serious impairments.

The President's Committee on the Employment of the Handicapped has stressed the fact that even the most seriously handicapped person, when properly motivated, is "ready, willing and able to work." And one of the slogans of this committee is, "All a man needs is a heart and a brain." How, then, can any bureau judge that a man is truly totally and permanently disabled by reading a short report on paper without any effort having first been made to provide him with complete rehabilitation facilities. I think, then, that major emphasis must be placed on rehabilitation of the disabled, rather than pensioning of the disabled.

When a physician is asked to determine whether a patient is disabled, he must ask himself the question, "Disabled for what?" One of the sub-committees of the Baruch Committee on Physical Medicine and Rehabilitation devoted itself to the study of the problem of physical fitness, and this committee concluded, "physical fitness, in the broader sense with which the physician is concerned, has no meaning, unless qualified 'for what'." In a similar fashion, disability has no meaning unless qualified "for what." . . .

4. The pattern of determination of total disability, according to the "disability freeze provision" of the Social Security laws (as recommended in H. R. 7225), will be wholly inadequate for determining the real need for permanent financial assistance. . . . [As] Chairman of the Governor's Advisory Committee on Vocational Rehabilitation in the state of Minnesota . . . I have investigated the activities of the disability freeze section of the Division of Vocational Rehabilitation in Minnesota. This section has acted promptly, in accordance with the provisions of the Bureau of Old Age and Survivor's Insurance and this is how it works.

As you know, the "freeze," which is somewhat comparable to the waiver of premium by an insurance company, means the freezing of of a person's benefit rights under the Social Security program, so that when he becomes 65 years of age and retires, or if he dies, he or his dependents will be entitled to whatever benefits he had to his credit at the time he became disabled. The claimant has to make an application and be responsible himself for furnishing medical evidence of his impairment, but, from the medical standpoint, he needs only to submit a one-page "medical report," Budget Bureau Form 72-R510.1, or it is provided that his physician may submit a report on his own letterhead, if he prefers to do so.

There is nothing to prevent the claimant from "shopping around," if he so desires, until he finds a physician who will give him a report which is to his liking. The claimant, then, submits this report to the Bureau of Old Age and Survivors' Insurance, which, in turn, passes it on to our State Division of Vocational Rehabilitation. The claimant's physician has been asked merely to supply medical findings, and he is not asked to pass judgment as to whether the patient is disabled. The "impairment" is determined by the physician and the decision as to whether or not the claimant is "disabled" is made by the adjudicator, according to a set of standards set up by the Bureau.

In Minnesota, the team making these determinations of "disability" consists of one half-time manager, one disability examiner, a physician, who devotes four half days per week to this work, and a full-time stenographer-secretary. Adjudication of disability is based entirely on the written reports submitted to the team, and the medical disability examiner makes no direct examination of the claimant. The first application was processed by our team in November, 1955. Up to De-

(Continued on Page 304)

HARRIET ELLEN GILLETTE

Recipient of the Richard Kovács Memorial Fellowship

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The Richard Kovács Memorial Fellowship Fund Committee has selected Dr. Harriet E. Gillette as the recipient of a $1,000.00 award. This fund was established in 1952 to help defray the expenses of a qualified person desiring to attend the Second International Congress of Physical Medicine, August 20-24, 1956, Copenhagen, Denmark.

Dr. Gillette, the daughter of a physician, was born and raised in Elgin, Illinois. She received her bachelor of science degree from the University of Chicago in 1936; she was awarded a medical degree from Rush Medical College in 1940. After interning at the New England Hospital for Women and Children in Boston, Dr. Gillette established private practice in Florida, specializing in diseases of women and children. In the summer of 1946, she was placed in charge of controlling a poliomyelitis epidemic in Tampa, Florida. After receiving a fellowship in physical medicine and rehabilitation from the National Foundation for Infantile Paralysis, Inc., Dr. Gillette obtained a year's training in physical medicine and rehabilitation at Warm Springs, Georgia; 6 months' training at Emory University, Georgia; and 3 months' training with Dr. Winthrop M. Phelps at Children's Rehabilitation Institute, Cockeysville, Maryland.

From 1948 to 1951, Dr. Gillette served as medical director of Ardmore Crippled Children's Hospital. Since 1951, she has been in private practice of physical medicine and rehabilitation in Atlanta, Georgia. In addition to her private practice, Dr. Gillette is a cerebral palsy consultant for the Crippled Children's Division, Georgia Department of Public Health; the National Society for Crippled Children and Adults, Inc.; the Georgia Crippled Children's Society; and the Florida Crippled Children's Society. She is also a consultant in physical medicine for the Veterans Administration, Southeastern Area; chairman of the Committee on Chronic Illness and Geriatrics, Fulton County Medical Society; and chairman of the Southeastern Section, American Congress of Physical Medicine and Rehabilitation.

Dr. Gillette has written several articles, principally on cerebral palsy, for scientific publications. She is a diplomate of the American Board of Physical Medicine and Rehabilitation; she is a member of the American Academy of Physical Medicine and Rehabilitation, American Congress of Physical Medicine and Rehabilitation, American Medical Association, Georgia Medical Association, Southern Medical Association, American Medical Women's Association, Georgia Medical Women's Association, Atlanta Society of Neurology and Psychiatry, American Geriatrics Society, National Rehabilitation Association, Inc., American Academy of Cerebral Palsy, International Council of Exceptional Children, and American Association of Mental Deficiency.

In 1955, Dr. Gillette was named woman of the year by the American Medical Women's Association.

(Continued from Page 302)

cember 31, 1955, 335 cases were received from local offices of the Bureau of Old Age and Survivors' Insurance, and 37 determinations had been submitted to the Federal Office in Baltimore. It is estimated that the present team can now process approximately 25 cases a week, but, as you can see, the whole program is still in its infancy, and the standards and procedures, which are now beginning to be developed for the limited purpose of freeze determination, will obviously be unsatisfactory for cash benefits. Whereas they may conceivably become suitable for a program which involves only limited incentives for malingering, they would seem to be wholly inadequate for a program in which we are trying truly to rehabilitate the disabled and to determine accurately whether a person is really going to be unable to support himself permanently. . . .

5. The much more promising program for rehabilitation (rather than pensioning) of the disabled, which is now being developed under existing Social Security laws, has not been fully supported and developed as yet. In the areas where it has been developed, it has been so successful that there is every reason to recommend the further expansion of such programs, rather than to embark now on a pension program which would be of dubious value.

For example, a year or so ago, the Federal Office of Vocational Rehabilitation reported that of 43,997 persons, who received physical and vocational rehabilitation, 22 per cent, or about 10,000, had never previously been gainfully employed, and nearly 90 per cent, or nearly 40,000, were not employed at the time they started their rehabilitation. The average annual wage of the entire group prior to rehabilitation was $148. After rehabilitation, the average annual wage of the group increased to $1,768. The total annual earnings of the entire group rose from approximately $6.5 million to approximately $78 million.

Prior to rehabilitation, the majority of these persons relied on general public assistance, not only for themselves, but also for their families. The annual cost of this assistance to the taxpayer was from $300 to $500 per case, but the total cost of their rehabilitation averaged only $300 per case. It has been estimated that for every dollar spent for rehabilitation, the Treasury has collected $10 in income taxes from the rehabilitated workers. . . .

Thus, from an economic standpoint, not only the disabled person, but the community is benefited, and instead of increasing taxes, the rehabilitation program has actually added to the federal income. I agree with the President's Commission on the Health Needs of the Nation, however, when it said: "The economic argument for rehabilitation work is a strong one, but the real goal is not a saving of dollars and cents. The real goal is human values. Saving life and enabling it to do the heretofore impossible requires depths of courage and brings out new wellsprings of satisfaction. Everyone is heartened by what the handicapped can do in the face of really great difficulties. In performing miracles of adjustment, they help keep others from succumbing to the small and trivial things of life." . . .

In January, 1954, President Eisenhower, in his special message to Congress on the nation's health problems, pointed out that there are "two million disabled persons who could be rehabilitated, and thus, returned to productive work. Only 60,000 are being returned each year. Our goal should be 70,000 in 1955 . . . for 1956, 100,000 . . . in 1956 the states should begin to contribute to the cost of rehabilitating these additional persons . . . by 1959, with . . . states . . . sharing with the federal government, we should reach the goal of 200,000."

The small, but rapidly growing number of medical rehabilitation centers, and the understaffed state vocational rehabilitation units, with the assistance of the Federal Office of Vocational Rehabilitation, are struggling, manfully, to meet these goals, but they still are finding difficulty in expanding because of shortages of personnel. If these agencies were suddenly to be swamped with a quarter of a million additional persons, as is recommended in H. R. 7225, many of them seeking, primarily, to get on "the gravy train" of a permanent pension, and only half-heartedly accepting attempts at rehabilitation, in order to comply with the requirements of this proposed law, the whole mechanism might easily break down and many worthy persons who are really seeking total rehabilitation might fail to obtain it for several years to come. . . .

6. For the small percentage of persons who are *truly* incapable of rehabilitation and *actually* totally disabled, there are many who will contend that there are better means of financial assistance already in existence than the means proposed in H. R. 7225. Already there has been established a program of aid to the permanently and totally disabled, which was enacted in 1950. Already, "permanent and total disability" benefits are provided under the Workmen's Compensation laws. We have also programs for unemployment compensation and, in various states, temporary disability programs. In addition, there are many disability programs provided by voluntary agencies and also voluntary health insurance plans. In support of my contention that there is only a small percentage of persons who are truly incapable of rehabilitation and actually totally disabled, I should like to quote a statement of the Sub-committee on Civilian Rehabilitation Centers of the Baruch Committee. This committee, under the Chairmanship of Dr. Howard A. Rusk, stated: "It has been estimated by experts in the field of rehabilitation and retraining that up to 97 per cent of all handicapped persons can be rehabilitated to the extent of gainful employment." Likewise, the 1952 report of the task force on the

handicapped, Office of Defense Mobilization, stated: "Yet, the most important single point to be remembered in considering plans for the handicapped today is the fact that we now are in the position to do more to overcome the handicapping effects of disability than at any time in our history. . . . During the past 10 years, there have been developments in the several fields relating to disability which have radically broadened the extent to which handicapped persons may be restored to activity and gainful employment. Because these developments have not occurred in a single dramatic step, their significance frequently has not been fully comprehended. Taken together, they already have made it possible for thousands of disabled men and women who, 10 years ago, would have been considered hopelessly impaired to resume active lives and to enter the labor force as self-supporting citizens." I agree with the conclusion "the term 'totally disabled' is a term we are today beginning to feel applies to very few people." I agree, also, with the conclusion: "Even for persons in the older age groups, self-sufficiency and independence through rehabilitation are incomparably more important than cash payment. Any benefit which diminishes the incentive toward rehabilitation and self-support is socially undesirable." . . .

7. It is now well-known among medical experts on aging that, from the health standpoint, it is much better to provide older persons with a useful occupation and a feeling of belonging to society than to shelve them on a pension. It is my understanding that the Department of Labor is now promoting the employment of older workers and there is a strong national trend toward the continued employment of elderly persons. In view of these efforts to provide employment for older persons (who, on reaching 65, can now expect to live, on an average, for 13 more years) it seems unwise to encourage retirement as early as age 50, on the basis of a simple certification of alleged total disability. I truly believe that such legislation would lead many older persons who are partially disabled to claim total disability and, thus, they would mistakenly be robbing themselves of the real pleasure of useful employment for a large portion of their lives. From a health standpoint, we should be helping disabled people to obtain some sort of employment so that they have a feeling that they are useful and needed as active workers in the community. It is unsound, medically and psychologically, to encourage dependency, which usually leads to discontent and unhappiness. . . .

8. Compulsory taxation and pensioning of large numbers of our people (as opposed to assisting them to self-support and self-sufficiency by modern methods of rehabilitation) is contrary to our American tradition in support of "life, liberty, and the pursuit of happiness."

I have devoted a major portion of my life to the development of medical procedures which will help disabled people toward self-sufficiency and self-respect. I feel certain that a very high percentage of the so-called permanently disabled can be rehabilitated. I believe so strongly in the American tradition of encouraging each citizen to stand firmly on his own two feet, to fight for independence and self-sufficiency, and to invest his own funds, without compulsion, as well as to make his own way in the world and provide for his own family, that I cannot help but urge on you the development of dynamic programs of rehabilitation, rather than the shelving of the disabled on a permanent pension plan.

9. The opportunity to receive financial assistance for alleged total disability frequently stifles all desire on the part of the individual to seek rehabilitation and return to self-sufficiency. I should like to cite two specific cases, as examples. The first is a 41-year-old patient seen recently in our rehabilitation center at the University of Minnesota who was paralyzed from the waist down following an accident. This man could walk very well on crutches and the rehabilitation experts were quite certain that he could work as a shoe repairman with proper training, or in a chicken hatchery. However, this man had been transferred from the County Welfare Board support to an arrangement for assistance under the 1950 law granting aid to the totally and permanently disabled. Under these circumstances, he had absolutely no motivation to return to self-sufficiency and was content to remain inactive for the rest of his life.

The second case is a patient, 31 years old, having poliomyelitis, who was seen at the Rehabilitation Center at the University of Minnesota in 1955, three years following his original attack of poliomyelitis. He was on a pension of $135.00 a month for the non-service connected disability. He was married and received $45.00 a month from A. D. C. (Aid to Dependent Children). He had mainly weakness of the legs and some weakness of the shoulders; however, his forearms and hands were good. This patient was a pleasant, passive individual, who accepted his physical condition with all of its limitations. He readily admitted his lack of employment interest. He did not have the initiative to seek work. The Rehabilitation Center had a fairly good job lined up for him that fitted in with his disability (a position as a cashier), but the patient refused it because he was perfectly willing to stay on the $180.00 pension. . . .

I have been a consultant to the Veterans' Administration, and, in particular, I have studied the paraplegia center at Hines, Illinois, and it is frequently the observation that the paraplegic veteran who receives financial assistance and is provided with a car is content to remain incapacitated. Almost invariably, also, we find that such paraplegics are much less happy and get into more difficulties than

those who do find employment and become useful members of the community.

An Alternative Plan to that Proposed in H. R. 7225

I should like to propose an alternative plan to that proposed in H. R. 7225, which I think will serve the disabled people of this nation more effectively and more humanely.

1. Continue to support fully the development of medical and vocational rehabilitation under existing laws (notably the Hill-Burton, Public Law 725, 79th Congress and the amendment program, Public Law 482, 83rd Congress).

2. Stress the importance of dynamic physical, mental, social, and vocational rehabilitation of the disabled person, rather than the static and medically and psychologically unsound procedure of shelving the disabled person on a pension.

3. Establish a study commission or advisory council with broad powers to investigate *all* phases of the Social Security program before enactment of any further legislation.

(a) Request this commission or advisory council to make a thorough investigation of ways in which existing laws can make the promising rehabilitation programs still more effective.

(b) Request this commission or council to weigh carefully the relative merits of active rehabilitation versus static pensioning.

(c) Request also that this commission or council attempt to determine a suitable and effective procedure for assuring that each disabled person is given full opportunity for restoration to self-sufficiency through modern rehabilitation procedures.

(d) Request the commission or council to explore means of providing financial assistance under already existing laws for the relatively small number of persons who are truly totally and permanently disabled and cannot be rehabilitated.

(e) Request the commission or council also to seek a much more accurate means of determining actual total permanent disability than is now available under presently developing arrangements for the so-called disability freeze provision of the social security laws.

(f) Request the commission or council to publicize widely its findings, so that the people of this nation can be fully informed concerning all phases of our Social Security program and make a wise, country-wide decision concerning its future development (this would be preferable to any hasty legislative action at this time. In fact, we need more time to evaluate the effectiveness of promising existing legislation for the welfare of the disabled before we add to our tax burden by enacting new laws which would further extend Social Security along lines of dubious value).

4. Take the Social Security issue out of politics. The welfare of our disabled citizens is far too important for it to be subject to the vagaries of political expediency.

In closing, I should like to quote a statement made by John Galsworthy, the English novelist, at the Allied Conference on the After-Care of Disabled Men, held years ago, here in Washington, D. C., just after World War I. Galsworthy said: "A niche of usefulness and self-respect exists for every man, however handicapped; but that niche must be found for him. To carry the process of restoration to a point short of this, is to leave the cathedral without a spire. To restore him, and with him, the future of our countries, that is the sacred work."

Book Reviews

The reviews here published have been prepared by competent authorities and do not necessarily represent the opinions of the American Congress of Physical Medicine and Rehabilitation and/or the American Academy of Physical Medicine and Rehabilitation.

INDIVIDUALISATION EN EDUCATION PHYSIQUE. By *Paul Frankard* and *Denise Walckiers.* Paper. Price, 45 Fr. b., (0,90 dollar). Pp. 115. E. Nauwelaerts, Place Cardinal Mercier, Louvain 2, Belgium, 1954.

This little book deals with a big problem in physical education, that of keeping the demands of assigned exercises within the range of a child's capacities. One need not go far into the past within his own circle of experience for instances of the overgrown, mentally sluggish boy playing with the smaller children in his class, or of the myopic girl terrified by having a baseball thrown at her.

The authors soon get deep into the difficulties of sorting out school children into homogeneous groups by anatomical and functional criteria. Some of the facts they unearth are especially instructive, such as the maximum (at age 14) in the curve for the coefficient of variation for weight as a function of age. The important work of Crampton on puberty is not mentioned, but other more recent American work receives due attention. The usefulness of the book would have been greatly increased by an alphabetical subject index; this lack is but poorly remedied by the table of contents at the end.

RHEUMATOID ARTHRITIS AND PSORIASIS VULGARIS. Internal and Cutaneous Manifestations of the Permanent Endoparasitism in the Homo Sapiens. Their Common Etiology, Pathogenesis, and Specific Vaccine Therapy. By *Tibor Benedek,* M.D. Cloth. Price, $12.00. Pp. 308. Edwards Brothers, Inc., Ann Arbor, Mich. Distributed by Chicago Medical Book Company, Jackson and Honore Sts., Chicago, 1955.

Privately published this monograph reviews similarities between rheumatoid arthritis and psoriasis vulgaris. The author discusses a pilot study based on treatment of 94 patients. He vigorously presents the cause of these diseases as an organism described as B. endoparasiticus and he strongly recommends specific vaccine therapy.

Dr. Benedek is a dermatologist whose interest in these conditions was stimulated by the misfortune of developing rheumatoid arthritis. He was further stimulated by the recovery of one of his soldier patients whom he treated for psoriatic arthritis with the vaccine of B. endoparasiticus.

The book is a concise summary of much that has been written on rheumatoid arthritis and psoriasis. There are a few pictures and some statistical tables. Therapy is limited to medical methods and usually to vaccine. The use of physical medicine methods is not discussed.

Dr. Benedek quotes from an appraisal of current therapy in rheumatoid arthritis by Ragan and his co-workers in August, 1952: "The crying need in the present treatment of rheumatoid arthritis is for an understanding of the pathogenesis of the disease particularly its etiological factors, and for some definitive indices of a poor prognosis early in the disease."

The author hopes that his monograph will be the answer to this crying need. Based on the evidence that he presents, including the pilot study, Dr. Benedek has somewhat less than realized his hope.

THE CARE OF YOUR SKIN. By *Herbert Lawrence,* M.D. Cloth. Price, $2.50. Pp. 95, with illustrations. Little, Brown & Company, 34 Beacon St., Boston 6, 1955.

The adolescent and young adult who has acne will find this small volume a source both of help and understanding for his physical and emotional problems. It is written in an easy style, and the medical terms used are well defined. Subjects covered are structure of the skin, cause of acne, misconceptions of the disease, treatment and development of the proper attitudes. A concise outline is appended in the form of treatment, diet and health memos. This book can be recommended to teen-agers suffering from common skin ailments.

THE CLINICAL USE OF CORTICOTROPIN, CORTISONE AND HYDROCORTISONE IN EYE DISEASE. By *Dan M. Gordon,* M.D. Cloth. Price, $3.75. Pp. 88, with 21 illustrations. Charles C Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1954.

The author stated that the monograph is presented as an aid to the practitioner; it will serve this purpose because it is well written and concise in the description of the

use of ACTH, cortisone and hydrocortisone in the treatment of diseases of the eye. The author made use of his own extensive clinical experience in discussing the effects of these new drugs. Photographs are used to show external diseases of the eye and to demonstrate several retinal lesions. A section is devoted to long-term treatment for chronic diseases. Actual description of untoward effects is not given but dosage schedules and other ways of minimizing side effects are suggested.

The only criticism is that the monograph is too brief. However, it provides a general survey of the field for the general practitioner and a reference source for the ophthalmologist.

HEALTH, CULTURE AND COMMUNITY. Case Studies of Public Reactions to Health Programs. Edited by *Benjamin D. Paul* and *Walter B. Miller*. Cloth. Price, $5.00. Pp. 493, with illustrations. Russell Sage Foundation, 505 Park Ave., New York 22, 1955.

"Health, Culture and Community" is a collection of case studies designed to demonstrate the kind of assistance health workers may expect from teaming up with social scientists. It also brings to the social scientist a well-rounded picture of his contribution to the solution of health problems; 16 case studies are presented. They are drawn from various parts of the world, including South and Central America, Africa, Asia, and the North American continent. Each case study was written by a person or persons directly involved in the action described. All had lived in the community under discussion long enough to assess the situation at first hand. The cases selected were tested in numerous staff or teaching seminars at the Harvard School of Public Health and therefore reflect the reactions and criticisms of seminar participants. Although each case is complete in itself, the series is held together by the remarks of the editor who introduces each study. His comments are followed by a statement of the problem to be discussed, an analysis of the situation, what was done, what happened, and the implications of the experience. Each case study ends with a summary and a brief annotated list of selected references.

The major thesis of the monograph is that if you wish to help a community improve its health you must "start with people as they are and the community as it is." The weakest link in the chain of health protection is in the application of stores of available health knowledge. This is evident especially when health work deals with individuals, when it is dependent for success upon the consent of the persons involved, and when it calls for radical changes in personal habits. All of the cases studied are of this kind. Concepts of health and illness are woven into the sociocultural fabric of all peoples. They must be ascertained and understood before asking that new health habits be assumed.

The 16 cases are grouped into 6 sections under the following headings: Reeducating the Community, Reactions to Crisis, Sex Patterns and Population Problems, Effects of Social Segmentation, Vehicles of Health Administration, and Combining Service and Research. Workers in the field of Physical Medicine and Rehabilitation will find Case 12 especially illuminating. This documents what happened in a Chilean Health Center when the public health nurse was removed from the doctor-nurse-patient triad.

"Health, Culture and Community" should prove useful to physicians, lay health workers and technical experts, administrators, and those interested in the social sciences. It is a stimulating and instructive book, presented from a point of view which is probably unfamiliar to most medical practitioners. Many corollaries can be drawn which throw light on the perennial problem of interpersonal relations in the team approach to health service, as well as ways and means of gaining the confidence and cooperation of disabled patients with many different cultural backgrounds.

RADIOBIOLOGY SYMPOSIUM 1954. Proceedings of the Symposium held at Liege, Belgium, August-September, 1954. Edited by *Z. M. Bacq* and *Peter Alexander*. Fabrikoid. Price, $9.80. Pp. 362. Academic Press, Inc., Publishers, 125 E. 23rd St., New York 10, N. Y., 1955.

This collection of fifty papers is mainly of importance for the radiobiologist, the cellular physiologist and the enzyme chemist. Subjects dealt with are hydrogen peroxide formation by radiation, protective measures against biochemical effects of radiation, various shielding procedures, radiation effects upon enzymes, viruses, mitochondria and chromosomes, and radio sensitization. There are also a few papers on animal and human physiology in relation to radiation effects. The great variety of papers and the discussions permit a stimulating insight into the research activities and problems of radiology. Thereby the volume extends its interest beyond the group of directly involved researchers and should reach the larger circle of those interested in biochemical progress.

POLIOMYELITIS. By *Robert Debre*, et al. Cloth. Price, $8.00. Pp. 408, with illustrations. Columbia University Press, 2960 Broadway, New York 27, N. Y.; World Health Organization, Palais des Nations, Geneva, Switzerland, 1955.

This is an interesting and well thought out presentation of poliomyelitis as a worldwide endemic disease.

The sections on epidemiology, serology, immunology and public health control measures are exceedingly well done. Most interesting to this reviewer however is the excellent section on respiratory poliomyelitis which is unusually complete. It carried particular import because most of us are aware of the ingenuity the Copenhagen group showed in handling their problems in a recent poliomyelitis epidemic. All physicians need assistance in this emergency situation, and the problems are outlined and dealt with in a very practical way.

In this country some may take issue with the impression of European workers that tank respirators should be used only for patients with pure spinal respiratory insufficiency and are not effective in bulbar poliomyelitis. They also used Cuirass respirators in the acute stage, a procedure not used widely in the United States. They do admit however that the Cuirass respirator is not suitable for the patient with greatly reduced vital capacity because it does not produce sufficient ventilation and frequently causes bed sores. The methods they have devised to use positive pressure ventilation through a tracheotomy opening were interesting.

Perhaps the section on the clinical aspects would have been enhanced by a contribution by an author from the United States. Most of the photographs of the equipment used in respiratory poliomyelitis are of European design and are not generally available here.

This easily read volume is a truly international approach to the present concepts of the pathology, epidemiology, immunology and treatment of poliomyelitis. It is to be recommended for every specialist in physical medicine and will be of great value to pediatricians, internists, serologists and immunologists who are interested in the treatment of poliomyelitis and related diseases.

SIGNIFICANCE OF THE BODY FLUIDS IN CLINICAL MEDICINE. By *Alexander Leaf*, M.D., and *L. H. Newburgh*, M.D. Second edition. Paper. Price, $2.50. Pp. 72. Charles C Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1955.

The reviewer feels that this is an excellent book for one who has recently studied physiological chemistry. It is however beyond comprehension of individuals who are neither closely nor currently associated with the field. The authors leave the impression they should be more clinical and less academic in the treatment of their subject.

HANDBOOK OF TREATMENT. By *Harold T. Hyman*, M.D. Cloth. Price, $8.00. Pp. 511. J. B. Lippincott Company, E. Washington Sq., Philadelphia 5, 1955.

"Handbook of Treatment" is just what it is intended to be — "A convenient and realistic type of book to be used by general practitioner as well as specialist for ready reference." The book is clear, concise and adequate in the outline of the treatment of all conditions including abdominalgia to herpes zoster. The publication is worthwhile.

Physical Medicine Abstracts

The Painful Shoulder. S. M. Albert, and A. M. Rechtman. Am. Pract. & Digest Treat. 7:72 (Jan.) 1956.

The authors briefly review the causes of painful shoulder related to disease some distance from the shoulder, such as cervical disk, intrinsic thoracic disease such as acute coronary occlusion, various pulmonary lesions, and peripheral vascular disease. The remainder of the paper concerns local disease which the authors divide into three main categories: 1. Disease of the musculotendinous cuff — a. Tears, b. Degenerative changes with and without calcification; 2. Subacromial bursitis — a. Primary, b. Secondary, and 3. Bicipital tenosynovitis (periarthritis).

Degenerative supraspinatus tendinitis is the most frequent cause of shoulder pain. These degenerative changes may be well advanced without causing symptoms, because they are buried in a tissue almost devoid of nerve or blood supply. Tenosynovitis of the supraspinatus causes the pain and since the tendon sheath is the synovial floor of the subacromial bursa, it is difficult to dissociate supraspinatus tendinitis from subacromial bursitis.

The authors are convinced that the acromion process is very important in the mechanism and origin of the painful shoulder since apparently only the subacromial bursa, of the 6 or 8 bursae around the shoulder, falls heir to disease. Chronic trauma due to impingement against the acromion occurs. Relief of

nocturnal pain, by hanging the extremity over the side of the bed, by walking, and the relief by acromionectomy confirms this opinion.

The authors doubt very much whether primary subdeltoid bursitis occurs except in rare instances.

The stiff painful shoulder is a self-limited disease, and the sole indication for treatment is to minimize pain and shorten the duration of the condition. Since acute pain in the shoulder is a consequence of an acutely inflamed bursa associated with muscle spasm, two methods of treatment are suggested. These are release of tension and removal of irritating calcaneous and tendinous debris by aspiration, and adhesive traction to the extremity to relieve spasm and to move the site of the lesion from further acromial impingement.

Rest is of prime importance in the treatment of early bicipital tenosynovitis (periarthritis). The position of rest should be with the arm in abduction and maintained by use of a splint. In later more chronic stages, the authors favor manipulation under anesthesia. Gradual stretching and physical therapy cause more pain over a longer period than manipulation under anesthesia. Lippman suggests suture of the long biceps tendon to the lesser tuberosity. This fixes the tendon and relieves pain. It does not release the already formed adhesions about the intra-articular portion of the tendon.

Definitive Bracing in the Treatment of Cerebral Spastic Paralysis of the Extremities. Sidney Keats. J. Internat. Coll. Surgeons **25**:35 (Jan.) 1956.

Contracture of the Achilles tendon with accompanying pes equinus is the deformity most frequently associated with the spastic lower extremity. A brace is used at night to stretch the contracted heel cord and prevent deformity of the foot. The brace consists of a shoe, laced above the ankle, to which is attached a single round bar with a cuff below the knee and a right-angled posterior ankle stop. This brace also can be used postoperatively after surgical lengthening of the heel cord.

Long leg braces, with knees locked in full extension, and a spreader bar are used in cases of overactivity of the gracilis muscles. This type of brace also can be used for spastic adductors of the thigh or in a scissors gait. It is necessary to attach a pelvic band to long leg braces when there is marked overactivity of the hip flexors and internal rotators of the thigh. Ball-bearing hip joints are then used to neutralize the thrust of the scissors action. In general, long leg braces with a pelvic band are used in training a child to walk who has a scissoring gait or adduction contractures. If internal rotation is not severe the pelvic band may be omitted and a posterior rotator strap can be attached to upright extensions on the lateral bars of the leg braces.

When there is a mild degree of internal or external rotation of the legs, not due to spasticity of the rotators and not accompanied by tendency to flexion of the knee, elastic "twisters" can be used for gait training. These attach to a canvas belt worn about the waist and are wrapped around the legs, terminating in buckles on the shoes.

The Incidence of Atelectasis After Heart Operations With and Without Breathing Exercises. B. Strandberg. Ann. Phys. Med. **3**:18 (Jan.) 1956.

The incidence of atelectasis after heart operations was compared in two groups — those in whom pre-operative and post-operative breathing exercises were done and those in whom they were not done. There were 99 in the first group and 97 in the second. The preoperative diagnoses were Tetrology of Fallot, patent ductus and coarctation of the aorta. There was a very similar division of cases in each group.

The exercises consisted of arm and shoulder movements, diaphragmatic breathing and localized expansion of various areas of the lung. They were given one week pre-operatively and four to five weeks post-operatively.

In Group I, 33 cases developed post-operative atelectasis. Five of the 33 died. In Group II, 9 developed atelectasis and none died. In Group I there were three deaths due to endocarditis, cerebral thrombosis and cerebral hyperemia respectively. In Group II there were two deaths due to hemorrhage and cerebral thrombosis respectively.

Since the technics of chemotherapy, fluid replacement and anesthesia were the same in both groups it would appear that breathing exercises are of value in preventing atelectasis.

The Medical Student. John R. Ellis. J. M. Educ. **31**:41 (Jan.) 1956.

The author, sub-Dean of the London Hospital Medical School of the University of London, expresses some thoughts on medical students generally and on differences between British and American medical students in particular. It is his feeling that both British and American medical students are poorly educated. This he ascribes chiefly to poor standards of science teaching and early scientific education.

He also makes the point that most medical students dislike responsibility and attain responsibility late in their medical training. They also prefer dogmatism and the quick brilliant therapeutic result. It is his opinion that the American student works harder and is more serious and that he would be better off with more recreation and athletic activities. Generally, he feels that competition is keener in America and that the curriculum and teaching is better. He thinks that American

students would do well to start more practical, clinical work earlier. He ends on a happy note implying that the internship must be the graveyard of the poor medical student and the birthplace of the good physician.

The comments are interesting. It should be mentioned that the author's opinions are definitely influenced by the quality of the medical schools which he visited in this country.

Prednisone and Prednisoline Therapy in Rheumatoid Arthritis Clinical Evaluation Based on Continuous Observations for Periods of Six to Nine Months. Edward W. Boland. J.A.M.A. **160(8)**:613 (Feb.) 1956.

The purpose of this study was the appraisal of the therapeutic merits of prednisone and prednisoline in 141 patients with rheumatoid arthritis. Their effect was also compared with that of hydrocortisone. The patients were followed over periods from six to nine months and the average duration of the arthritis was 126 months.

The patients were divided into three groups — those who had never been or had not recently been on hydrocortisone therapy, those whose arthritis had previously been adequately controlled on hydrocortisone and those whose condition had not been adequately controlled on hydrocortisone.

The maintenance doses of prednisone or prednisoline were 5 — 15 mg. per day by mouth, approximately one-fourth that of hydrocortisone.

On the newer derivatives gastric complaints, ecchymoses and vaso-motor symptoms increased markedly in all three groups of cases. However, there was much greater difficulty with salt and water retention when hydrocortisone was being used.

The new derivatives are not ideal suppressive agents and problems in management and potential hazards related to depression of the adrenal cortex still exist with their use.

Physicians now ought to think of the proper steroid as well as the indications for selection of candidates for steroid therapy.

Effect of Chlorpromazine on Convulsions of Experimental and Clinical Tetanus. R. E. Kelly, and D. R. Lawrence. Lancet **270**:118 (Jan. 21) 1956.

The authors noted the effect of chlorpromazine on the convulsions produced by tetanus in both experimental and clinical conditions. Tetanus toxin was injected into the hind leg of a rabbit to produce an experimental resting tetanus. The other leg of the rabbit was used as a control. One mg. of chlorpromazine per kilogram of body weight administered intravenously abolished all muscle spasm in the extremity for an average time of 77 minutes. This was true even when an afferent stimulus was applied to the leg. The authors also reported on one clinical case involving the treatment of a two year old male afflicted with tetanus.

Chlorpromazine was administered intravenously by way of an intravenous drip through the entire course of the disease which lasted 16 days. The dosage varied with the degree of involvement and on one day amounted to 330 mg. At no time was the respiration affected but the patient could be aroused at all times. The patient went on to a complete recovery.

It would seem that chlorpromazine is a very effective agent for the treatment of tetanus in that muscle spasm was abolished without markedly affecting either the respiration or consciousness.

Chronic Poliomyelitis Respirator Deaths. R. A. Blossom, and J. E. Affeldt. Am. J. Med. **20**:77 (Jan.) 1956.

Because of frequent inquiries relative to the prognosis and expected complications in chronic respirator patients, the authors carefully analyzed the cause of death in 15 cases that occurred in a large chronic poliomyelitis respiratory center. The more interesting findings were as follows:

Bronchopneumonia was a direct cause of death in 4 patients and a contributing cause in 5 others. Five had associated abscesses of the lung. The predominant organisms found were Proteus vulgaris and Pseudomonas aeruginosa. These two organisms are very resistant to antibiotics. There were 10 cases of atelectasis and 8 of emphysema — those patients who were in the respirator the longest had the most emphysematous involvement. Six patients had layers of homogenous acidophilic material lining the alveolar ducts that was similar to "hyaline membrane disease" found in newborn infants. Theoretically, this would form a barrier to gas exchange.

Although the cardiovascular system rarely contributed to deaths, 8 patients had right ventricular hypertrophy, 11 had left ventricular hypertrophy, and 5 others had dilatation of the heart chambers. Eight cases showed a subacute or healed myocarditis.

The gastro-intestinal system was a common source of complications. Abdominal distension with signs of gastro-intestinal bleeding occurred in 11 cases. At autopsy, ulceration was found in the distal esophagus in six patients, in the stomach in six and in the duodenum in one. Two patients died as a result of gastro-intestinal hemorrhage.

Eighty per cent of these cases had renal or other genito-urinary calculi. Proteus vulgaris and Pseudomonas aeruginosa were again found to be the most frequent organisms infecting the urinary tract.

The average age of these patients was 24 years, and they lived an average of 13.08 months after they developed poliomyelitis.

However, these figures are not very meaningful, because two of the patients lived 3.5 and 4.5 years, respectively, and if these are excluded from the study the average period of survival drops to 9 months.

Changes in the Length and Position of the Segments of the Spinal Cord with Changes in Posture in the Monkey. C. G. Smith. Radiology **66**:259 (Feb.) 1956.

This study was undertaken to measure the changes in the length and position of individual spinal cord segments when the trunk is flexed and when the extremities are moved into position which puts traction on the peripheral nerves.

Rhesus monkeys were sacrified and one-half of the skull and vertebral column was removed so that the brain and cord were well visualized. Pins, ⅛ inch long, were inserted into the cord along the line of attachment of the dorsal roots, each pin being placed where the lowest rootlet of one nerve met the highest rootlet of the nerve just caudal to it. Three pins were inserted into the brain stem, one at the level of the obex, the second at the junction of the medulla and pons, and the third at the junction of the pons and the midbrain.

Nails inserted into the vertebral bodies and in the bones of the lower limbs served as reference points. The location of the pins in the cord and in the nerves was recorded roentgenographically for each posture.

During flexion of the trunk all segments of the cord and hindbrain moved toward the mid-cervical region, that is, the level of the disc between the 4th and 5th cervical vertebrae. From the mid-cervical to mid-thoracic region, each segment moved upward toward the head progressively more. The segment at the level of C6 moved upward 5.9 mm., that is, from the level of the 6th to the 5th thoracic vertebrae.

Traction on the sciatic nerve produced by flexing the hip with the knee extended and the foot dorsiflexed caused 4 mm. of downward movement of the cord at the pelvic rim. Movement in both the sciatic and posterior tibial nerves was toward the knee.

Caudal movement of the lower cervical segment was noted when traction was applied to the outstretched upper extremity.

This study would indicate that the spinal cord is quite extensible and is also subject to much movement within the vertebral canal.

The Apparent Absence of Significant Primary Vasospasm in Acute Spinal Poliomyelitis. A. W. Trott, et al. Pediatrics **17(2)**:230 (Feb.) 1956.

It has been postulated that peripheral vasospasm is responsible for the pain, tenderness and the so-called "spasm" of muscles during the acute stage of poliomyelitis. It is known that vasoconstriction producing a cold clammy skin is present in weak or paralyzed extremities in the chronic stage of poliomyelitis. Therefore, the authors, in this study, have attempted to determine whether vasoconstriction also is present during the acute stage of poliomyelitis.

Qualitative evaluations of blood flow determined through measurement of the temperature of the skin and muscle were performed on 40 patients with poliomyelitis during the first 40 days of their illness. Comparative studies were made on the paralyzed and normal extremities of the patients and on the extremities of normal persons. There was no difference in the temperature gradients in the paralyzed and non-paralyzed extremities, and therefore it was assumed there was no change in circulation. On the first comparison with the normal persons it was found that a slight drop in temperature occurred in the patients. However, when the normal persons were placed at rest the temperature of the skin and muscle showed a similar decline to that of the patients, suggesting that the lowered temperature was caused by rest rather than being the result of poliomyelitis.

The authors believe their findings in acute poliomyelitis are in keeping with the pathologic studies which indicate that primary involvement of the sympathetic nervous system is rare in poliomyelitis. They suggest that sympathetic block and other measures to reduce vasospasm are of no value in treatment of poliomyelitis.

Dangers of Delaying Speech Therapy. Robert W. Plummer. Arizona Med. **13**:8 (Jan.) 1956.

The average age of the patients seen by the author for speech therapy during the last 15 years was 7+ years, exclusive of adults. An individual learns more from birth to age 6 than during any other 6-year period. It is easier, with assistance, for the speech defective to achieve normal speech during the natural speech development period of under 6. Speech defects become more deeply rooted and more difficult to correct after the age of 5 years.

A great majority of stutterers 6 years and under can be corrected in 6 months while those over 6 years require 8 to 10 months. Severe dyslalia, in which speech is quantitatively normal but qualitatively unintelligible, usually can be corrected in 12 months if therapy is begun when the child is 4 or 5 years old, but they require a minimum of 18 months if therapy is delayed beyond age 6. Psychological trauma is an added reason for early speech therapy. This becomes especially important when school age is reached.

Some children do outgrow speech defects, but this is all too commonly accepted as being true by parents, teachers, relatives, etc. The author found that 22 per cent of all first graders had defective speech in 20 elementary

schools in Phoenix, Arizona. He also found that 18 per cent of all eighth graders had defective speech, which is a relatively small decline in 8 years. Improvement in the defects will be even less from the eighth grade on.

Education of parents, schools and every agency which contacts the speech defective is the only answer to the problem. It is just as sensible to treat all speech disorders persisting beyond age 5 as it is to immunize against all diseases in which it is possible to do so.

Chlorpromazine and Human Spasticity. J. V. Basmajian and A. Szatmari. Neurology 5:856 (Dec.) 1955.

This article is a follow-up report on an electromyographic study of the effect of rapid intravenous injection of chlorpromazine on human spasticity. Fifty mgm. of the drug was the dose used in the preliminary report, but in the newer study 0.5 mgm. per kilogram of body weight was used. Recordings of the resting muscles, tendon reflexes, voluntary contractions, irradiation phenomena, and clonus were made before the injection of chlorpromazine and at measured intervals afterward.

Dramatic abolition of spasticity for about two hours was obtained in 15 of 18 patients with spasticity due to upper motor neuron lesions of various etiology, including cerebral palsy and paraplegia. Lesser effects were obtained in the other three cases. In a boy with cerebral palsy the effect lasted more than 20 hours. Voluntary muscular activity was unaffected except in one quadriplegic who reported a brief transient paralysis of a partially affected limb. The effects were not related to state of consciousness. Most patients remained highly co-operative, though some became quite sleepy.

No effect was noted on the involuntary movements or the reflexes in five cases of chorea-athetosis and no depression was seen in a normal subject's neuromuscular responses.

Two cases of parkinsonian tremor were relieved temporarily, in contrast to the occasional appearance of such a tremor in long-term therapy for psychosis with chlorpromazine and reserpine.

The authors were very cautious in translating their experimental results into possible therapeutic application, preferring to leave this to clinicians.

The possible mode of action of the drug was discussed. The effect is apparently a depression of overbalanced facilitatory influences of the brainstem reticular nuclei. In this regard, further work with normal subjects must be done, since it has been observed that there may have been an increase in the normal stretch reflexes in normal persons. The fact that there was not a depression of the normal stretch reflex in nonspastic individuals indicates that the effect of the drug is not at the level of the spine but rather in the brainstem.

Extrapyramidal conditions are caused by release of the motor cortex proper (Brodmann area 4) from the premotor cortex (Brodmann areas 6 and 4S) via striopallidonigrothalamic pathways. Therefore, chlorpromazine will affect extrapyramidal conditions only when cortical functions are depressed. Hence, it is not surprising that the cases of choreo-athetosis were unaffected by the drug except when actual sleep was allowed to occur. The paradox of parkinsonism remains to be explained.

The Treatment of Pressure Sores in Paraplegic Patients. Rowland Osborne. Brit. J. Plast. Surg. 8:214 (Oct.) 1955.

The author states that there would be few, if any, pressure sores if patients could be admitted to spinal injury units directly after the accident. All ulcers can be closed with the possible exception of the trochanteric leading into an infected hip joint. Having been closed, given an intelligent co-operative patient made "sore conscious," there should not be any recurrence. The great bugbear of surgery for pressure sores is the uncertainty as to whether all vessels have been tied. The surgeon must be alert for hematoma formation and deal with it at once.

The specific plastic treatment of sacral and trochanteric sores is discussed. With ischial sores the author reserves ischialectomy for thin patients who have had a recurrence.

Herniated Cervical Disk and Atypical Facial Neuralgia. Muscle Spasm as a Pain Factor. B. D. Judovich, and G. R. Nobel. Lancet 75:453 (Oct.) 1955.

Headache and atypical facial neuralgia frequently accompany herniated cervical disk or other mechanical painful lesions of the cervical spine. The mechanism of this associated pain may be due to irritation of descending or spinal roots of the trigeminal nerve with transmission of pain to head and face, and sympathetic pain caused by reflex stimulation.

The concept that muscle spasm causes pain *per se* when it exists in conjunction with or is precipitated by an accompanying lesion it may cause additional pain, thus producing a vicious cycle, appears to be fallacious in certain respects. Spasm of muscle and pain are caused directly by intrinsic disturbances of muscle, such as trauma, hemorrhage, inflammation, etc. Another type of muscle spasm due to reflex action occurs in tension headaches or herniated cervical disk.

The authors believe that muscle spasm associated with a "mechanical" painful neck, such as a herniated cervical disk, is reflex in nature, and for the following reasons does not of itself cause pain: 1) Production of muscle spasm by electrical stimulation for 20 minutes during a headache did not increase symptoms in a small group of patients; 2) shortening of the muscle by downward pressure and/or tilt-

ing the head in a patient with a cervical disk definitely aggravates pain and radiation, and 3) forty to 50 pounds of traction in patients with cervical disk instantly relieves pain; however, this theoretically should aggravate pain when a muscle is in spasm as it does in acute torticollis. Muscle spasm in instances of the scalenus anticus syndrome does cause added pain, but this is due to its strategic location and the effect on the subclavian artery and brachial plexus.

Conservative treatment for herniated cervical disk consists of heavy traction — 30 to 35 pounds — administered intermittently by a motorized device or a simple device to be used at home. Procaine injection is used if reflex spasm of the scalenus anticus is causing pain. Headache associated with painful lesions of the cervical spine, if not relieved by traction and ordinary analgesics, should have the region of the occiput injected. Hydergine is helpful in these headaches as well as in the tension type of headache. A supporting collar may be necessary in some cases.

The authors believe that headache associated with painful lesions of the cervical spine is likely to be vascular in origin because: 1) Only irritation of a blood vessel on tapping the tender occipital points can produce the distribution of pain that occurs; 2) bilateral symmetrical distribution of pain, often throbbing, points to vascular rather than nerve involvement; 3) the superficial temporal artery and the carotid artery frequently are tender in addition to their being tender occipital points; 4) procaine injection of the region of the occipital artery and nerve relieves the headache and does not produce anesthesia of all painful areas, does not eliminate muscle spasm of the neck, nor does it account for the area relieved of pain when the occipital nerve is anesthetized, and 5) hydergine, a vasodilator, often relieves this pain. This, plus relief by procaine injection, suggests a vasoconstrictor mechanism.

Physical Dynamics of the Cough Mechanism. B. B. Ross, et al. J. Appl. Physiol. **8(3)**:264 (Nov.) 1955.

Studies of the physical changes accompanying coughing were made by measuring the rate of flow of air, esophageal pressure and the effects of externally applied pressure on an autopsy specimen of trachea, and also by visualizing changes in the tracheal diameter by using x-ray motion pictures and fluoroscopic studies.

During a cough a high linear velocity airstream with high kinetic energy is produced, which will displace objects lodged in the airway. It is this high linear velocity (approximately 28,000 cm./sec.) in a cough that distinguishes it from a forced expiration (approximately 4700 cm./sec.). The rate of flow of air in forced expiration and cough is about the same (5-7 liters/sec.). Mean linear velocity varies inversely to the area of the cross section diameter of the trachea. During a cough, the rapid reduction in the diameter of the trachea produces the high linear velocity. In forced expiration this reduction does not occur.

The mechanism producing these diameter changes must be the closure of the glottis preceding the expirating phase of the cough. This permits the high initial expiratory pressure and a high pressure gradient across the walls of the trachea and bronchi once the glottis is opened. X-ray motion pictures show an abrupt change in tracheal diameter and no evidence of a wave-like progression of diameter changes along the bronchial tree as has been suggested.

Mechanical cough apparatus is essentially a decompression chamber that induces a sudden mouth-chest pressure gradient of about 40 mm. Hg. During a normal cough this gradient is 100 to 140 mm. Hg. This difference in mouth-chest pressure gradient (normal cough vs. artificially induced methods) suggests there is little change in the caliber of the airway, and therefore little change in resistance. Hence there is little change in linear velocity as compared to the normal cough.

Electrical Stimulation in the Treatment of Muscular Trismus and Periarticular Fibrosis of the Temporomandibular Joint. F. J. Sheffield; R. A. Gregg, and A. F. Mastellone. Am. J. Phys. Med. **14**:612 (Dec.) 1955.

The problem of trismus and partial ankylosis of the temporomandibular joint is constantly plaguing both the dentist and physician in general practice. The authors present this article to stress the benefit of electrical stimulation in restoration of mobility to the joint. They stress that only when the problem is periarticular without bony involvement is the treatment advantageous.

Several etiological factors are discussed and the anatomy of the joint is mentioned briefly. The dominance of the elevator muscles (temporal, masseter, and internal pterygoid) over the strength of the depressor musculature is also noted.

Six cases with resultant periarticular involvement of the temporomandibular joint are presented. All were treated with a pulsating alternating current applied through two electrodes secured to the joints. Pulsations of 2-4 per second were used and treatments were carried out twice daily. Supervised active exercise to the jaw was also used.

In all cases there was a marked increase in the range of motion of the temporomandibular joint.

Electromyographic Changes in Myasthenia Gravis. R. J. Johns, et al. Am. J. Med. **19(5)**:679 (Nov.) 1955.

Electromyographic studies of the properties of the neuromuscular block in myasthenia

gravis were made. The characteristic features observed on electrical stimulation of the ulnar nerve were as follows: 1. There is a partial block of the transmission of a single impulse; 2. after the passage of a single impulse there is an increase in the degree of block which reaches a maximum about one second after passage of the impulse; after 10 seconds the block clears; 3. a train of impulses results first in a progressive increase in the block. Then follows a transient decrease in block. This is succeeded in turn by a progressive increase in block which rises as the frequency of stimulation is increased, and 4. a brief period of facilitation of neuromuscular transmission follows tetanizing stimulation. This apparently represents a decrease in the myasthenic block and is probably prefunctional in origin. However, this facilitation decreases the ability of the myasthenia to transmit subsequent impulses.

The authors found a close resemblance between the neuromuscular block in myasthenia and that produced by d-tubocurarine in normal subjects. This suggests that the myasthenic block could be produced by a competitive (or curare-like) block.

Reflex Hyperemic Deossification (Sudek's Atrophy). Joel Hartley. J. Mt. Sinai Hosp. **22**:268 (Nov.-Dec.) 1955.

That Sudeck's atrophy or reflex hyperemic deossification is caused as a result of either trauma or infection is generally accepted. Trauma, however, is the most common initiating cause and often is of a minor degree. The site of involvement may be at the injury area or may be separated by one or more joints. It is more common in the upper extremities about the hand, wrist, and forearm.

The clinical picture is characterized by progressively increasing pain which may eventually spread to involve the root of the limb. The affected area at first is warm, dry, tender, and edematous. It later becomes more edematous but cold and cyanotic. Spotty deossification begins to appear at about four to six weeks, with secondary trophic changes involving the skin, muscle, and nails appearing somewhat later.

X-ray changes first appear as discrete mottlings especially prominent in the carpals and metacarpals. Deossification in the metaphyseal zones or throughout the whole bone are noted. These ultimately may progress to diffuse rarefaction of all portions of the bone or several bones.

Early in the process there is dilatation of the blood vessels with increased flow. Later, as vasospasm begins the extremity becomes cold and cyanotic. However, even with vasospasm, the process of deossification continues.

Treatment is primarily one of early recognition with institution of carefully graded activity, weight bearing, and rehabilitation. Persuasion and encouragement are important and should be stressed. Prophylaxis consists of preventing poor immobilization, too early rehabilitation, or prolonged immobilization.

Heat Therapy for Ischemia in the Lower Extremities. K. R. Woolling, and C. Wilson. Diabetes 4:389 (Sept.-Oct.) 1955.

The authors describe a heat cradle or box for controlled heating to promote vasodilatation and aid in healing of ulcers and infections, and in the relief of pain in ischemic extremities. The heating unit, a thermostat, and a thermometer are mounted near the end of the box. The heating unit consists of 12 incandescent lamps mounted on a board bridging the lower border of the box end. The lamps are wired as four groups, with three lamps in each group and the thermostat is connected with the circuit. Each of the three lamps comprising a group is connected in series with the other two lamps of the group, and each of the four groups is connected in parallel with the other three groups. The pattern of mounting the individual lamps in the same group is staggered so that no two lamps in the same group are side by side. When the thermostat was adjusted so that the thermometer in the end of the box was 90 F., the temperatures inside the therapeutic compartment never exceeded 97.9 F. or fell below 87.1 F. The temperature at points nearest the heating unit ranged for the most part between 90 and 95 F., the generally accepted ideal range.

"Hot spots" are avoided with this device and it therefore affords additional safeguards against burning.

Studies of Thorium X Applied to Human Skin. IV. Clinical and Autoradiographic Findings Following the Introduction by Iontophoresis. P. Fleischmajer, and V. H. Witten. J. Invest. Dermat. **25**:223 (Oct.) 1955.

After a pilot study revealed that iontophoresis of Thorium X increased the penetration of the substance through absorbent papers, this procedure was attempted in three human volunteers.

To the upper aspect of the volar surface of both forearms, a square of blotting paper saturated with Thorium X saline solution was applied. To the middle of the volar aspect of the left forearm a square of paper saturated with saline solution was applied. An electrode connected to the positive pole of a galvanic circuit was applied to the blotting paper saturated with Thorium X saline solution for 20 minutes at 2 ma. The procedure was repeated for the blotting paper containing only saline solution. The other site served as a control.

Two hours later excision biopsies were done of the two sites in which Thorium X solution was used. Frozen sections were made and autoradiograms prepared.

The clinical biological effects of Thorium X, as evidenced by erythema and pigmenta-

tion, were enhanced by iontophoresis. Penetration of Thorium X, as evidenced by the autoradiograms, was also definitely enhanced by iontophoresis. Speculation followed as to the therapeutic effectiveness of this method in various dermatologic conditions, such as keloids, thickened lesions of lichen simplex chronicus and prurigo nodularis, forms of nevus flammeus, plaques and tumors of mycosis fungoides.

The Problem of Pressure Sores in Spinal Paraplegics. L. Guttmann. Brit. J. Plast. Surg. 8:196 (Oct.) 1955.

The mechanism of development of pressure sores depends on intrinsic and extrinsic factors. Intrinsic factors include lowering of tissue resistance to pressure especially during spinal shock stage; sensory loss; anatomical arrangement of certain parts of the body; spasticity of the limbs; nutritional deficiency; anemia, and infection. The extrinsic factors include maceration from exposure of skin to moisture and pressure, the immediate cause of ischemia and development of sores.

Pathologically, the following stages of development of a bedsore can be distinguished — stage of transient circulatory disturbance; stage of permanent damage to cutaneous tissues; stage of deep penetrating necrosis; infection of sores; the closed ischial bursa, and cancerous degeneration of sores or scars.

The treatment can be divided into general methods, local methods and plastic repair. The general and local methods are aimed directly at the various intrinsic and extrinsic factors in the production of sores. Prophylactic measures from the outset are of paramount importance and if properly applied will prevent the occurrence of these lesions. The author decries the use of the popular rings which have been found to produce sores by sheering stress and recommends proper use of pillows and Sorbo packs. Other factors are discussed and emphasis is placed on making the patient "pressure conscious" both as a preventive and in the pre- and post-operative period once sores have developed. The plastic repair of these pressure sores is briefly discussed, special mention being made of the method used for the treatment of ischial sinus sores, called "pseudo-tumour" technic.

Optical Density of Serum in Cancer Compared with Findings in Patients Having Other Diseases and in Normal Persons. J. A. Quinn; S. A. Katz, and A. E. Rappaport. Am. J. Clin. Path. 25:1120 (Oct.) 1955.

The authors first noted a difference in the optical density of serum from normal patients and those with cancer of one form or another.

Tests were carried out on 914 patients originally in an attempt to establish norms for subsequent testing. The patients were divided into three groups, 1) normal, 2) pregnant females and patients with diseases other than cancer, 3) patients with cancer.

Blood samples were obtained and the optical densities of the serum were determined before and after refrigeration. The differences were determined and were plotted against the standardized values.

Of 477 normals tested, true negative results were obtained in 97.7 per cent of the cases. True negative results were noted in 86.3 per cent of the patients who were either pregnant or had a disease process other than cancer. Of 313 patients with biopsy-proven carcinomatosis, a true positive result was noted in 90.1 per cent of the cases.

The results of the study are indeed interesting. Though it is simple enough to be utilized in mass studies the reliability is not such as to recommend its widespread use.

The Distribution of the Permanent Paralysis in the Lower Limb in Poliomyelitis. W. J. Sharrard. J. Bone & Joint Surg. 37-B:540 (Nov.) 1955.

The belief that some order exists in the apparently irregular distribution of permanent paralysis in poliomyelitis has been expressed by several authors. The author presents a series of 142 patients in whom paresis or paralysis could be detected in 203 limbs three years after the onset of poliomyelitis.

The quadriceps and hip abductors (gluteus medius and maximus) led in frequency of affection but the muscles of the leg were those most frequently paralyzed. The ratio of paresis to paralysis was lower in the muscles of the leg (tibialis anterior, tibialis posterior, and long toe flexors and extensors) and higher in the hip flexors and adductors. However, the incidence of paralysis in the intrinsic muscles of the foot was low.

The highest incidence of paralysis was found in the L2 and L3 segments. Below this level there was a uniform decrease in the numbers of affected muscles.

The spinal cord in the normal and in poliomyelitis was compared by noting the number of motor cells remaining in the affected cord at the clinical level of involvement and comparing with a normal cord.

Using a method of reconstruction, called projection microscopy, the author compared the spinal cords of seven patients who had had poliomyelitis with patients who had normal cords.

Again it would seem that the 2nd and 3rd lumbar segments were those most frequently and extensively involved. In a transverse plane the center of the anterior horn appeared to be the most vulnerable area.

The relationship between the distribution of paralysis and the destruction of motor nerve cells was noted. The paralysis appeared to be in exact agreement with the distribution of

motor cell destruction. Muscles supplied by short columns of cells were the most frequently paralyzed; those supplied by the long columns were more likely to be paretic.

When the whole of the motor column that supplied a muscle had been destroyed it was likely that one or more adjacent motor columns that occupy the same length of spinal cord would be completely destroyed or severely affected.

This associated paralysis could also be applied to prognosis. When both associated muscles were paralyzed prognosis was very bad. When both associated muscles were paretic or normal there was an excellent prognosis.

Medical News

Members are invited to send to this office items of news of general interest, for example, those relating to society activities, new hospitals, education, etc. Programs should be received at least six weeks before the date of meeting.

New Procedures for Stable Isotope Distribution Announced

Simplified procedures for the domestic and foreign distribution of stable (non-radioactive) isotopes and rare earths produced by the U. S. Atomic Energy Commission were announced by Chairman Lewis L. Strauss.

Under the revised procedures, neither domestic nor foreign applicants will be required to file and obtain Commission approval of applications before purchasing the materials. Requests and purchase orders will be handled directly between the user and the AEC facility supplying the materials. Electromagnetically-concentrated stable isotopes will be available for sale to domestic users; they were previously available only on a loan basis. Reports of results of experiments using the materials will not be required from either U. S. or foreign applicants.

The export of deuterium or deuterium compounds to any country listed as a Subgroup A (Soviet Bloc) country in Section 371.3 of the comprehensive Export Schedule of the U. S. Department of Commerce is prohibited. Export of deuterium or deuterium compounds to any other country requires a special export license from the Department of Commerce. Prior approval of the Atomic Energy Commission must be obtained for sale of any other stable isotope to a person in a Soviet Bloc country.

The Commission will establish annual or special quotas of the total quantity of each item to be distributed and the maximum amount which will be available to any one person, firm or institution without special Commission approval. Samples of rare and expensive items may be loaned, provided they will not be diluted or contaminated during use.

Sale prices and charges for loan of the materials will be established by the Commission. The Commission will distribute only those materials which are not available commercially, unless the requestor certifies that the commercial product does not meet purity or quantity specifications required for his research.

Stable isotopes have had important applications in basic research in such fields as biology, medicine, chemistry, and metallurgy. Rare earths also are of research interest. Stable isotopes currently available for distribution include Deuterium, Helium-3, Boron 10 and 11, Oxygen 18, Argon 38, and the electromagnetically-concentrated isotopes of approximately 80 elements. The rare earths included in the distribution program are those in the Lanthanide Series: Elements 58 to 71 inclusive. Other items may be added to the list as they become available.

Stable isotopes, except deuterium, are distributed by the Stable Isotopes Research and Production Division, Oak Ridge National Laboratory, Oak Ridge, Tenn. Under the revised procedures, the Commission's Savannah River plant will sell deuterium oxide (heavy water) in bulk quantities to any domestic distributor. The minimum and maximum amounts that may be purchased are 200 and 400 pounds, respectively. Inquiries should be sent to the Savannah River Operations Office, U. S. Atomic Energy Commission, Post Office Box A, Aiken, S. C.

Purchasers may resell deuterium oxide in the smaller quantities used for research and development. Previously, such quantities were distributed only by the Stuart Oxygen Co., San Francisco, under contract with the Commission.

Rare earth elements are available from the Commission's Ames Laboratory, Iowa State College, Ames, Iowa.

Books Received

Books received are acknowledged in this column as full return for the courtesy of the senders. Reviews will be published in future issues of the journal. Books listed are not available for lending.

The Macmillan Medical Dictionary edited by Sir Cecil Wakely; **Doctors Are People** by W. Gerg Mann; **The Doctor Writes** edited by S. O. Waife; **Arthoplasty** by St. J. D. Buxton; **Muscular Contraction** by M. Dubuisson; **Laboratory Aids in Endocrine Diagnosis** by Roberto F. Escamilla; **Anterior Poliomyelitis** by Lewis J. Pollock; **The History and Conquest of Common Diseases** edited by Walter R. Bett; **Textbook of Anatomy and Physiology — 13th Edition** by Diana Clifford Kimber and Carolyn E. Gray; **Introduction to Psychiatric Occupational Therapy** by Gail S. Fidler and Jay W. Fidler; **Special Education for the Exceptional — Volume I: Introduction and Problems, Volume II: The Physically Handicapped and Special Health Problems** edited by Merle E. Frampton and Elena D. Gall; **Corticotropin and Cortisone in Rheumatoid Arthritis. Clinical and Experimental Investigations** by Finn Fischer; **Self-Help for the Arthritic. A Course of Home Treatment for the Commoner Types of Arthritis** by David White; **Postural Back Pain** by Milton C. Cobey; **Surgery in World War II — Vascular Surgery** edited by Daniel C. Elkins; **Surgery in World War II — Hand Surgery** edited by Sterling Bunnell; **Peripheral Vascular Disease** by A. J. Barnett and J. R. E. Fraser; **Varicose Veins. Phlebitis, Leg Ulcers, Dropsy, Eczema, Haemorrhoids** by R. Rowden Foote; **Textbook of Occupational Therapy. With Chief Reference to Psychological Medicine** by Eamon N. M. O'Sullivan; **Your Blood Pressure and How to Live with It** by William A. Brams; **Progress in Biophysics and Biophysical Chemistry. Volume VI** edited by J. A. V. Butler; **Current Therapy 1956. Latest Approved Methods of Treatment for the Practicing Physician** edited by Howard F. Conn; **Proceedings — The Institute on Rehabilitation Centers** compiled by National Society for Crippled Children and Adults, Inc.; **Pelvo-Spondylitis Ossificans. Rheumatoid or Ankylosing Spondylitis. A Roentgenological and Clinical Guide to its Early Diagnosis (Especially Anterior Spondylitis)** by Ragnar Romanus and Sven Yden; **Joint Ligament Relaxation Treated by Fibro-Osseous Proliferation. With Special Reference to Low Back Disability — Trigger Point Pain and Referred Pain** by George Stuart Hackett; **The Fields of Group Psychotherapy** edited by S. R. Slavson; **Special Education for the Exceptional. Volume III — Mental and Emotional Deviates and Special Problems** edited by Merle E. Frampton and Elena D. Gall; **Physiotherapy in Some Surgical Conditions** by Joan E. Cash; **Poliomyelitis — Papers and Discussion Presented at the Third International Poliomyelitis Conference** compiled and edited for the International Poliomyelitis Congress; **Preventive Medicine in World War II, Volume III. Personal Health Measures and Immunization** edited by John Boyd Coates, Jr.; **Acute Head Injuries in Boxers. Clinical and Electroencephalographic Studies** by L. E. Larsson, et al; **Vocational and Professional Monographs — Soap and Detergent Industry** by Oliver M. Gale; **Is Your Halo On Straight?** by Glenn Curtis; **The Exceptional Child Faces Adulthood. Proceedings of the 1955 Spring Conference of the Child Research Clinic of the Woods Schools.**

Recent Publications by Members

Nila Kirkpatrick Covalt and co-author, "The Place of Low Volt Currents in Hydrotherapy: Hydrogalvanism and Allied Currents." The Physical Therapy Review, February, 1956.

Jack Meislin and co-author, "The Management of Attitudinal Contractures in Psychiatric Patients." The Physical Therapy Review, February, 1956.

Maxwell D. Flank with co-authors, "Management and Rehabilitation of the Bedridden Patient." Illinois Medical Journal, February, 1956.

James W. Rae, Jr., and Leonard F. Bender, "Treatment of Patients with Rheumatoid Arthritis by Physical Means." The Journal of The American Medical Association, February 25, 1956.

Albert A. Martucci, "Recent Survey of Physical Medicine and Rehabilitation Facilities in Pennsylvania." The Pennsylvania Medical Journal, February, 1956.

Walter J. Treanor, and Raoul C. Psaki with co-authors, "Potential Reversibility of the Hemiplegic Gait." United States Armed Forces Medical Journal, February, 1956.

Frank H. Krusen, "Physical Medicine and Rehabilitation: Its Significance and Relationship to Other Specialties in Medicine." The Pennsylvania Medical Journal, February, 1956.

Grace M. Roth, "Smoking and the Cardiovascular System." Minnesota Medicine, February, 1956.

Arthur S. Abramson with co-authors, "The Physiologic Basis of Electrodiagnosis." The Physical Therapy Review, January, 1956.

A. P. Hudgins, "Local Anesthesia for the Uterus and Cervix." The Western Journal of Surgery, Obstetrics and Gynecology, January, 1956.

Frederic J. Kottke, "Physical Medicine (*editorial*)." Minnesota Medicine. November, 1955.

The following articles were published in Department of Medicine and Surgery, Pro-

gram Guide Physical Medicine and Rehabilitation, December 30, 1955:

Carrie E. Chapman and co-author, "Electrical Stimulation of Muscle Groups."

Richard V. Freeman, "Why a Lay Coordinator in Medical Rehabilitation."

Delilah Riemer with co-author, "Community Employment Project at Bedford VA Hospital."

Herman C. Lund with co-author, "Teamwork Through a Ward Rehabilitation Conference."

Stanley F. Radzyminski and co-author, "Evaluating the Results of Coordinated Efforts of the Medical Rehabilitation Board."

Harry H. Samberg and co-author, "Adaptations of the Wheeled-Barbell."

Newly Registered Therapists

February 10, 1956

Ortenzio, Rocco A., 1621 Paxton St., Harrisburg, Pa.
Roman, Michael P., 3 E. Buttonwood St., Hazleton, Pa.
Welner, Harold S., 326 N. Beech St., Syracuse, N. Y.

February 18, 1956

Cochren, Donald Ray, 315 W. Washington St., Oakland City, Ind.
Davis, Jean M., 1706 Curtis St., Baton Rouge, La.
Erkus, Richard F., 228 Bay 34 St., Brooklyn
Solomon, Pearl, 337 E. Saylor St., Atlas, Pa.

February 28, 1956

Klein, Marilyn P., Avondale Apts., 17 and Jackson, Corvallis, Ore.

March 2, 1956

Rockwell, Donald C., 618 W. Highway, South Sioux City, Neb.

AMERICAN ACADEMY OF PHYSICAL MEDICINE AND REHABILITATION

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— MEMBERSHIP NEWS —

Archives of Physical Medicine and Rehabilitation

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The Bells Are Ringing

In cities, towns and villages all over America, the ringing of church bells one day in April will mark the launching of the annual Cancer Crusade of the American Cancer Society. At the same time, in many doctors' offices, the staccato ring of door and telephone bells will mark the success of a major objective of the Society.

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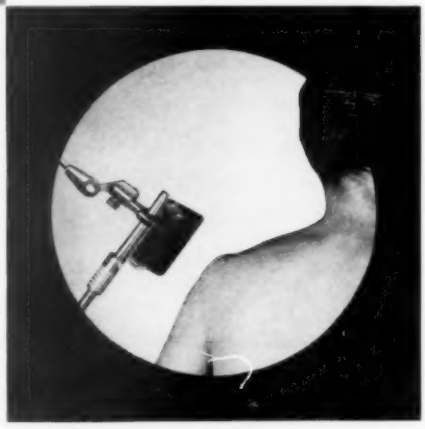

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* Queries and Minor Notes: J.A.M.A. 157:1360 (April 9) 1955.

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August 20 - 24, 1956 • Copenhagen, Denmark

Scientific Program

MONDAY, August 20, 10:00 a.m.

The Opening Ceremony in the Festival Hall of the University of Copenhagen, Frue Plads, Copenhagen K.

The lighting of the Ceremonial Lamp by the President of the International Federation of Physical Medicine.

Installation of the President of the Congress by the President of the International Federation of Physical Medicine.

Presidential Address: Dr. Sv. Clemmesen.

Speech of Welcome by the Chairman of Dansk Fysiurgisk Selskab, Dr. Ole Sylvest.

Lecture by Dr. Sv. Clemmesen.

MONDAY, August 20, 2:30 p.m.

Subject: **The Heat Regulation and Peripheral and Central Circulation as Basic Problems within Physical Medicine.**

Chairman: Professor Ejnar Jarlov, M.D., Denmark.

TUESDAY, August 21, 10.00 a.m.

Subject: **The Striated Muscle. Clinical and Physiological Problems in Relation to Physical Medicine.**

Chairman: Professor K. M. Walthard, M.D., Switzerland.

WEDNESDAY, August 22, 10:00 a.m.

Subject: **Rehabilitation.**

Chairman: Frank H. Krusen, M.D., U.S.A.

THURSDAY, August 23, 10:00 a.m.

Subject: **Clinical Communications.**

Chairman: L. T. Wedlick, M.D., Australia.

FRIDAY, August 24, 10:30 a.m.

General meeting of the International Federation of Physical Medicine. Report from the Honorary Secretary, Ph. Bauwens, M.D.

Closing ceremony by the President, Sv. Clemmesen, M.D.

Detailed information regarding this meeting may be had from the Office of The Secretary General: B. STRANDBERG, M.D., KOBENHAVNS AMTS SYGEHUS, HELLERUP, DENMARK.

Local boy makes good

WHEN THE LATE Ebenezer Hubbard, a patriotic Concord man, left a bequest for a local statue, there luckily happened to be a real sculptor close at hand.

Even more luckily, young Dan French had never yet sculped a whole statue—had, in fact, recently started by whittling on turnips. So he'd take the job for expenses, and glad to get it.

Two years later, Daniel Chester French's first statue went up. And Mr. Emerson, a neighbor, gladly obliged with a little verse to go under it, ending—

"Here once the embattled farmers stood,
And fired the shot heard round the world."

Now, during his great lifetime, Daniel French was to make many more statues, but his fame needs only two to rest secure. One is the massive, brooding figure in the Lincoln Memorial. The other is his first: the big, bold, living bronze of the Minuteman of Concord.

When, in 1941, a symbol of American strength was sought, the President picked the Minuteman. Ever since, the Minuteman has been the emblem of the great savings program that helped—and still helps—keep America and her people safe and secure. This year, the 15th anniversary of U. S. Series E Savings Bonds, finds 40 million Americans owning $40 billions of Bonds. Are you among them? For your own security—and the nation's—invest in Savings Bonds regularly. And hold on to them!

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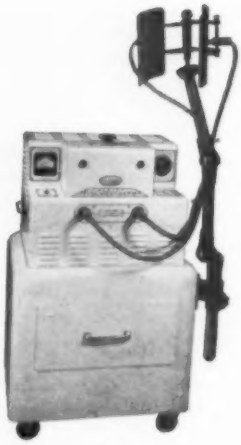

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(Partial listing of papers scheduled for future publication in *Archives*)

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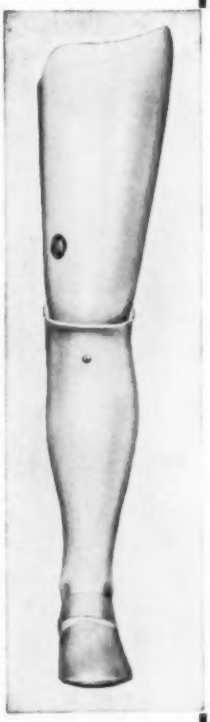

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1. Any subject of interest or pertaining to the field of physical medicine and rehabilitation may be submitted.

2. Manuscripts **must be** in the office of the American Congress of Physical Medicine and Rehabilitation, 30 N. Michigan Ave., Chicago 2, not later than June 1, 1956.

3. Contributions will be accepted from medical students, interns, residents, graduate students in the pre-clinical sciences, and graduate students in physical medicine and rehabilitation.

4. The essay must not have been published previously.

5. The American Congress of Physical Medicine and Rehabilitation shall have the exclusive right to publish the winning essay in its official journal, the ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION.

6. Manuscripts must not exceed 3000 words (exclusive of headings, references, legends for cuts, tables, etc.), and the number of words should be stated on the title page. An original and one carbon copy of the manuscript must be submitted.

7. The winner shall receive a cash award of $200, a gold medal properly engraved, a certificate of award and an invitation to present the contribution at the 34th Annual Session of the American Congress of Physical Medicine and Rehabilitation at The Ambassador, Atlantic City, N. J., September 9-14, 1956.

8. The winners shall be determined by the Prize Lecture Committee composed of four members of the American Congress of Physical Medicine and Rehabilitation.

9. All manuscripts will be returned as soon as possible after the name of the winner is announced.

10. The American Congress of Physical Medicine and Rehabilitation reserves the right to make no award if, in the judgment of the Prize Lecture Committee, no contribution is acceptable. The Congress may also award certificates of merit to contributors whose essays may be considered second and third best submitted. Announcement of the winner will be made after the annual meeting.